RAILROAD GAZETTE

FRIDAY, DECEMBER 4, 1903.

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Contributions

The Origin of the "Dandy Cart."

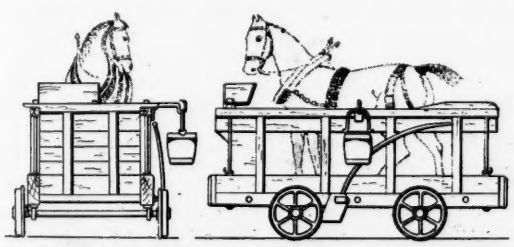
Newcastle-on-Tyne.

TO THE EDITOR OF THE RAILROAD GAZETTE:

I should be much obliged if you could assist me to elucidate a small point of railroad history. In 1828 the Stockton & Darlington Railway introduced on their line the "Dandy Cart," a low truck at the end of a set of wagons, in which the horse rode down the inclines. George Buchanan, in his account of the Lanarkshire Railways (1832) says: "This plan was first practiced in America on the Mauchunk (Mauch Chunk) Railway."

The question I should like to have solved is: Was the Stockton & Darlington Railway indebted to the Mauch Chunk Railway for the idea of this device, or vice versa?

The Switchback Railroad, as it was called, appears to have been opened in 1827. Could you ascertain for me



The "Dandy Cart" of the Stockton & Darlington.

whether the Dandy Cart was used on this line in 1827 and 1828, and, if not, when it was introduced?

I enclose a photograph of a drawing of the Stockton & Darlington Dandy Cart, as it appears to have been about 1841. The original truck was somewhat different.

WILLIAM W. TOMLINSON.

[The Mauch Chunk Railroad appears to be entitled to the prior claim on the "Dandy Cart" idea, as credited to it by Mr. Buchanan.

This road was built to connect the mines of the Lehigh Coal & Navigation Company on Summit Hill with the Lehigh River, nine miles distant. A historical account of the road states that it was begun in January and was completely in operation in May, 1827. The account explains that "the transportation of the coal is done by gravity, the empty wagons being returned to the mines by mules which ride down with the coal. The arrangement is entirely novel in its character and enables the mules to make two and a half trips to the summit and back, thus traveling about 40 miles each day."—EDITOR.]

Notes from Manchuria.

Port Arthur Nov. 1, 1903.

TO THE EDITOR OF THE RAILROAD GAZETTE:

It was asserted some time ago by an English writer, Mr. Walt Gerrare, in a book which he wrote about Siberia, that work on the Kiakhta-Pekin railroad had already commenced. Mr. Gerrare even gave photographs of this railroad which none of the English or American consuls or agents in the Far East had ever heard of; with the result that there was a good deal of speculation—some good people wondering what their paid representatives in China had been doing, and others wondering what the Muscovites were up to. It now seems to be pretty certain, however, that this railroad has not begun, although there is such a project. So at least I gather from a note in the current issue of the *Irkutsk Government Gazette* (*Irkutskia Gubernskia Viedomosti*) a paper published only for Russians and very unlikely to say that there was no Kiakhta-Pekin railroad if there really was one. This paper says that it has heard that the preliminary surveys of the railroad from Kiakhta to Pekin through Urga have been completed and sanctioned, and that in August next work will be begun on the new railroad, which will run a distance of 1,500 miles. Mr. F. O. Hirschmann is to have the principal direction of the works. He will be assisted by Mr. Ammosoff, another engineer.

While talking of the Manchurian Railway I may inform you that, according to the Russian papers, conferences are now being held at the Ministry of Finance in St. Petersburg with the object of doing away with some of the formalities connected with the passport system. This reform is undertaken for the benefit of travelers passing through Russia on their way to and from the Far East.

The rates on the Manchurian railroad are very high and the result is that everybody is grumbling. Russian merchants being as much handicapped as foreign merchants. A merchant who wants to send goods from Port Arthur to Harbin pays half as much as he would pay for bringing the same goods all the way from Milwaukee to Port Arthur; but in one case he knows exactly what he has got to pay, while in the other he never knows how many station masters and conductors he must "square" before the goods reach Harbin.

FRANCIS M'CULLAGH.

Eye-Bars or Cables for Manhattan Bridge.*

Montreal, Quebec, Nov. 12, 1903.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The conditions involved in the proposed change of plans of the Manhattan bridge have now passed beyond the stage where discussion can be put aside as being mere envious fault finding and the case in behalf of the change is clearly enough developed to justify a comparison of theories and conditions.

The original design of the Manhattan bridge is a three-span suspension bridge, with straight carbon steel wire cables and with a suspended stiffening truss hinged at the towers and anchorages and continuous over the centers of all three spans. The towers are steel, each comprising eight braced legs, and are self contained and fixed at the base. While the design contains general features common to both the Williamsburg and Brooklyn bridges, it differs very materially from both. Simplicity in general design and detail is perhaps here as strongly accentuated as is practicable in a bridge of such proportions, nor does it call for any radical departure from established practice in manufacture or construction. This design was fully developed, both as to general arrangement and essential details, before Jan. 1, 1902, and there were then on file in the Department of Bridges a large number of plans to clearly establish this fact.

The substitute design is a three span suspension bridge, with nickel steel eye-bar chains instead of straight wire cables, and with spandrel trussing connected directly with the chains, instead of the suspended stiffening truss. The towers consist of four massive legs braced transversely, but hinged at top and bottom so that they can rock longitudinally. The trussed chains are hinged at the towers, anchorages and center of the main span. The design embraces several radical departures from established practice in bridge manufacture and construction, the desirability and practicability of which is yet open to serious question. The type of this design is the same as that of the design for the Quebec bridge made by Mr. Lindenthal, but which failed of adoption. This latter design, however, embodied the patented Lindenthal wire link eye-bars instead of nickel steel eye-bars. These wire link eye-bars were orginally intended for the Manhattan bridge, but were afterwards abandoned.

THE REPORTS OF THE BOARD OF EXPERTS.

On Feb. 10, 1903, Mayor Low appointed a board of five eminent bridge engineers to answer certain specific questions relative to the substitute design for the Manhattan bridge.

The questions submitted to the board were as follows:

1. Are the plans in accordance with advanced knowledge of suspension bridge designing, with a view to economy of construction, provision for temperature stresses, rigidity under concentrated loads and resistance to wind pressure; also as to quality of steel and its protection against corrosion?

2. Will the strength, stability and carrying capacity of the bridge be adequate for any congestion of traffic that may occur on the railroad tracks, roadways and promenades?

3. Will the structure as designed be fireproof?

4. Do the plans admit of speedy erection of the superstructure after the completion of the anchorages and tower foundations?

On March 9, 1903, the board submitted to the Mayor a preliminary report, answering affirmatively, all of the foregoing questions, but reserving its decision as to the availability of the nickel steel proposed, until the results of certain investigations then in progress should be ascertained. However, in all other respects it appeared complete and final. The report is published in full in the *Engineering News* of March 12, 1903. The greater part of this report is devoted to a general description of the proposed design and some assertions as to the desirability of certain features, but it contained nothing that could be construed into confirmatory evidence. The final report, made on June 29, 1903, adds practically nothing to the preliminary report, except that the board is unanimously satisfied that nickel steel having, in annealed eye-bars, an elastic limit of 48,000 lbs., and an ultimate strength of 85,000 lbs. per sq. in., can be obtained.

It should be fully understood that improvements and new developments in the manufacture of material and in structural designing are constantly occurring, and that what a year ago might have been properly considered the best available, may to-day be replaced by something better; but the necessity for, or desirability of, putting off the old and tried and taking on the new and untried, especially in a work of such vast public importance as this, should be very fully demonstrated before being so recommended. Such matters can only be judged properly in the light of actual accomplishment and not in the light of opinions and promises, and without any desire to disparage the members of this board or the members of the engineering profession in general, no name or group of names can be adequate endorsement of any engineering proposition unsustained by adequate evidence.

Mr. George W. Colles, M. E., in a communication appearing in the *Engineering News* of July 23, gave expression to views which have been voiced in many quarters, if not so publicly, quite as emphatically. Among other things Mr. Colles says:

In the report of the Board of Experts on the Manhattan Bridge you have a good example of *engineering impressionism*, which, unfortunately, is too current among us. Many engineers appointed by capitalists or others to examine and report on a subject seem to think that all that is wanted is their bare opinion, and that their professional standing as experts settles the matter without further argument. Any criticism of such report from outsiders is too apt to be met with the reply, "Well, So-and-so is an expert on the subject and he knows what he is talking about." One may readily see to what abuse this follow-my-leader policy may lead. It is, of course, quite opposed to the scientific spirit. It enables the expert to shirk a critical and painstaking examination and substitute a mere superficial or offhand guess, which is unquestionably a fraud on his employer. It satisfies nobody and gives rise to endless and profitless discussion among the interested parties, like that deprecated by the *Engineering News*. In short, it shifts the burden of the real decision from the engineer to the capitalist—and, worse than all, it gives rise to accusations or suspicions or prejudice and favoritism, which may or may not be well founded.

The day has long passed when bridge design and manufacture advanced by leaps and bounds through radical individual conception and bold experiment. The stage of development has been reached where the most profitable study for the designer is the vast amount of excellent work already done, and experiment should be indulged in with great caution. Further, the dissemination of the knowledge of engineering designs is now so general that the engineer who would depart from established practice does so without title to credit unless he gives the reasons warranting his departure, especially when there is much evidence to prove that his departure is not only unwarranted by the necessities of the case but is a backward step in the attainment of the object in view. The controlling points involved in the comparison of straight wire cables and eye-bar chains are not so complicated or technical as to bar any intelligent engineer, or even an intelligent layman, from understanding them.

WIRE IS THE STRONGEST, SIMPLEST AND MOST RELIABLE FORM IN WHICH STEEL CAN BE USED FOR STRUCTURAL PURPOSES.

Wire can be drawn to No. 6 gage with a minimum ultimate strength of 200,000 lbs. per sq. in., and a minimum elastic limit of 180,000 lbs. per sq. in., with an average strength well above these lower limits. The quality of steel used, and the methods of manufacture of this high grade wire, are now well established by years of actual experience, and its quality can be made certain and uniform without undue expenditure of care, time, or money. The process of manufacturing high grade wire is in itself a form of refining which greatly aids in eliminating poor raw material and ensuring a reliable, finished product. Wire is readily susceptible of more thorough testing than any other form of structural steel, and in cable construction every individual wire can be stressed up to any desired point as it is laid in the strand by merely building up the individual strands with the versed-sine reduced

*This statement is made by Mr. R. S. Buck, Chief Engineer, Dominion Bridge Co., Montreal, and late Chief Engineer of the Manhattan bridge and also of the Blackwell's Island bridge, over the East River, New York City. For the convenience of some readers it is well to enumerate here the present and projected bridges across the East River, connecting the Borough of Manhattan, of New York City, with the Borough of Brooklyn. Bridge No. 1, commonly known as the Brooklyn Bridge, was opened for traffic in 1883. It is a suspension bridge with four wire cables supported on masonry towers. Bridge No. 2, known as the Williamsburg or New East River Bridge, is located about 1½ miles above the Brooklyn Bridge. It is a suspension bridge with four wire cables suspended on steel towers. It will probably be opened for traffic early in the spring of 1904, being now nearly completed. Bridge No. 3, known as the Manhattan Bridge, and which is the one referred to in this statement, is situated between the Brooklyn Bridge and the Williamsburg Bridge, about half a mile above the former. Plans and specifications have been prepared for an eye-bar cable susnension bridge with steel rocker-bent towers. The foundations for the piers are already completed. Bridge No. 4, known as the Blackwell's Island Bridge, is to cross the East River near the south end of Blackwell's Island, starting from East 59th street, New York. It will be a steel cantilever bridge with two river spans, two approach spans and one island span. The piers are completed and the contract for the superstructure has been let, the work to be completed in about 15 months.

sufficiently to produce the desired stress. The loss of strength in the finished cable, due to the wire splice, being almost unappreciable, the cable has practically the same strength per square inch as the component wires when they leave the wire mill. On account of its great strength wire can be used in a long span suspension bridge with a greater factor of safety and greater economy than is possible with any other available form of steel. Further, on account of the thorough test that the wire in a cable is subjected to, both in the manufacture and in placing, there is probably less liability of any defect occurring in such a cable than in any other form of bridge construction.

The contract price for the cables of the new East River bridge was something less than 15 cents per lb. It is only reasonable to infer that a similar contract let now would command a lower price on account of the practical demonstration that the stringing of the wires is neither very difficult nor unduly consuming of time. The price recently tendered for the nickel steel eye-bars for the Blackwell's Island bridge was 8.3 cents per lb. The erection of the bars in this case is, on account of the cantilever construction of the bridge, much less expensive than in a suspension bridge where a temporary bridge has to be used and the placing of the bars is made much more costly and difficult. It is safe to estimate the cost of a nickel steel eye-bar chain in a suspension bridge, according to the above tender, at not less than 10 cents per lb. The board of experts, in their preliminary report, stated that the nickel steel eye-bar chain will weigh something more than twice as much as what they consider an equivalent cable, or, say, 2.2 times as much. Therefore the comparative cost of the two systems is in proportion of 15 for cables to 22 for chains.

NICKEL STEEL EYE-BARS.

In the preliminary report, the board of experts, reviewing the substitute plans for the Manhattan bridge, say:

> The quality of steel [*i. e.*, nickel steel for the eye-bar chain] is the only novel feature about these cables, and, while the indications are that a steel will be obtained that will fully meet the requirements of the case, we ask to defer any final opinion on this subject for the present. If it should be found impracticable to get this high steel, similar chains can be made of steel which is in daily use, involving an increase in size of chains, but not modifying the general features of the design.

Although long span suspension bridges have received considerable attention for many years, this is perhaps the first time that it has been suggested that steel "in daily use" (presumably current medium steel) could be properly used for the chains of a suspension bridge of such proportions. This statement, to command credence, should have some definite substantiation. The use of eye-bars in bridge construction extends further back than the use of wire for the same purpose, and the results of the experience in their use is quite as well known. There has been no very marked improvement in the manufacture of eye-bars for 10 or 15 years, although the results of tests on eye-bars for the Wabash, Thebes, and Quebec bridges show perhaps some advance.

The tendency in bridge designing is distinctly towards forms of construction eliminating eye-bars, with the result that the quantity of eye-bars now used in truss bridges is much smaller as compared with the total output of such bridges, than it was several years ago. There has been for many years much controversy between designing engineers on the one side and the manufacturers of eye-bars on the other. The engineers anxious to extend the cheapness and simplicity found in smaller sizes of eye-bars to larger sizes, in order to meet the demands of longer spans and heavier construction, without having to resort to more complex forms of construction, have persistently urged the manufacturers to install plants capable of making much larger eye-bars than are in current use. The manufacturers on the other hand have insisted that 10 in. x 2 in. is the limit to which the size of eye-bars can be advantageously carried; and that the larger sizes are accompanied by such uncertainty, loss of strength, and difficulty of manufacture that they should be avoided whenever possible. Although there are now plants capable of making eye-bars 15 in. or even 16 in. wide, not enough of these bars have been manufactured to fully establish their desirability.

Mr. C. C. Schneider in the design which he made for the original Blackwell's Island bridge, on which work was begun but afterwards abandoned, in order to avoid the use of large forged eye-bars, adopted "built eye-bars" consisting of long plates with reinforced heads riveted on. Mr. Schneider also used this form of eye-bar in his design for the Quebec bridge. The Commissioner of Bridges endeavoring to furnish justification for 18 in. x 2 in. eye-bars in a communication in the *Engineering News* of Aug. 13, 1903, cites the case of the Buda-Pest bridge and says, "It is an eye-bar chain bridge of about 1,000 ft. span, the eye-bars being about 19½ in. wide and 1½ in. thick." He omits saying that these eye-bars were not forged, but were cut from plates as wide as the heads of the bars, an extraordinary method of manufacture never tried before and which probably will never be tried again.

Acid open-hearth steel showing in the test piece an ultimate strength of 60,000 to 68,000 lbs. per sq. in. and an elastic limit of about 33,000 lbs. per sq. in. has for a long while been generally accepted as the best available eye-bar material. This steel in full sized eye-bars 10 in. x 2 in. or less will as a rule develop an ultimate strength of about 55,000 lbs. per sq. in. and an elastic limit of about 28,000 lbs. per sq. in. There is thus a loss in strength in the finished eye-bar, due to heading and annealing, of about 10 per cent. in ultimate strength and 15 per cent. in elastic limit, as compared with the strength of the original unannealed bar from which the eye-bar is made. Of course this reduced strength is the only proper basis for estimating the strength of an eye-bar chain.

In the *Railroad Gazette* of Aug. 14, 1903, page 584, are given in detail the results of the full-size tests on 10 eye-bars from the lot manufactured for the Wabash bridge at Pittsburg, Pa. Of these eye-bars one was 12 in. x 1½ in., one 12 in. x 1¾ in., six 12 in. x $1^{13}/_{16}$ in., and two 14 in. x $1^{9}/_{16}$ in. They were made of basic steel, somewhat higher in carbon than is usual in eye-bar material, but were probably manufactured and annealed with greater care than was ever before observed; and the results, in the light of previous experience, are better than would naturally be expected. These tests if they can be sustained by more extensive practice, will mark a distinct but not great advance in eye-bar manufacture, chiefly in the use of high carbon basic steel for eye-bars, in the reduced loss of strength for larger sizes, and the closer approach in strength of the finished bar to the annealed test piece, although there is practically no closer approach in strength of the finished bar to that of the unannealed bar. The average loss of strength in the finished bars (omitting the one that broke in the head) is 10 per cent. in ultimate strength and 13 per cent. in elastic limit. There is nothing in these tests to warrant the conclusion that the 18 in. x 2 in. eye-bars proposed for the Manhattan bridge are practicable, especially in the light of the full size test of the 15 in. x 2 in. eye-bar with a 32 in. head, made by the Phœnix Bridge Co. for the purpose of ascertaining the largest eye-bar practicable for the Quebec bridge. This eye-bar when tested to destruction showed an elastic limit of 28,000 lbs. and an ultimate strength of 50,160 lbs. per sq. in. The loss in elastic limit and ultimate strength in the finished eye-bar is about 20 per cent. Some larger eye-bars tested for the same purpose gave such unsatisfactory results that they were rejected as being of impracticable size.

If nickel steel should prove unavailable and the necessity develop of having to resort to "steel in daily use" either the factor of safety of the chains of the Manhattan bridge will have to be reduced even to a lower figure than is proposed with nickel steel, or else the weight of the chains will have to be increased to a prohibitory point. In the Wabash tests the average elastic limit in the full size eye-bars is 34,400 lbs. and the average ultimate strength is 62,600 lbs., ranging as low as 30,140 lbs. and 54,660 lbs. Therefore an ultimate strength of 50,000 lbs. and an elastic limit of 28,000 lbs. per sq. in. for medium steel, and an ultimate strength of 55,000 lbs. and an elastic limit of 30,000 lbs. for high-carbon steel are the best minimum values that could be demanded in full size eye-bars of carbon steel at the present time; nor are there any indications that the standard can be raised.

THE KNOWLEDGE OF NICKEL STEEL FOR STRUCTURAL PURPOSES.

While nickel steel has been for many years a very interesting study, and has been properly considered possessed of great possibilities, its adaptation to practical uses has been extremely limited and slow of development. Mr. Albert Ladd Colby has recently published a very interesting pamphlet, for the purpose of promoting interest in nickel steel which is perhaps the most thorough compilation of data relating to this subject published; however, these data are wholly theoretical, experimental and academic, and contain nothing that establishes its value and availability as a structural material at the present time, whatever may be the promise for the future.

There is a great scarcity of experiments on full size nickel steel eye-bars, and an utter absence of tests on large nickel steel eye-bars. Mr. Ralph H. Watson in a paper read before the Engineering Society of Western Pennsylvania, and published in part in the *Railroad Gazette*, Sept. 4, 1903, gives the results of full size tests on 6 in. x 1½ in. and 6 in. x 2 in. eye-bars. Although the connection between the original bars and finished annealed eye-bars in the published extract is not very clear, it appears that the original bars showed by specimen tests were as follows:

	Elas. lim. Lbs. per sq. in.	Ult. strength. Lbs. per sq. in.
6 in. x 1½ in. bar	76,420	95,990
6 in. x 2 in. bar	73,430	97,550

In full size tests the results were as follows:

	Elas. lim. Lbs. per sq. in.	Ult. strength. Lbs. per sq. in.
6 in. x 1½ in. eye-bar (av. 3 tests)	49,510	85,963
6 in. x 2 in. eye-bar (av. 5 tests)	47,875	85,720

These tests show a loss in the finished eye-bar as compared with the original bar of 35 per cent. in elastic limit for both sizes of bars, and in ultimate strength of 10 per cent. for the 6 in. x 1½ in., and 12 per cent. for the 6 in. x 2 in. bars. These bars were made for test purposes, and the results, in consequence, are probably better than could be obtained in making bars in large quantities and of larger size. The very large loss in elastic limit, despite the comparatively small loss in ultimate strength, appears to be a prodigal waste of the working strength of the material.

For the Blackwell's Island bridge, the specifications for nickel steel require in the specimen test, 90,000 to 105,000 lbs. ultimate strength and a minimum elastic limit of 52,000 lbs. In the full size eye-bar a minimum of 85,000 lbs. per sq. in. ultimate and 48,000 lbs. elastic limit is required. It will be practically impossible to meet these requirements, as the margin between the strength of the unannealed bar and the finished annealed eye-bar is entirely too narrow. Either the former must be raised or the latter lowered.

If the City of New York is to be finally committed to the use of eye-bars of a size and material so untried, it would appear an imperative precaution to make such tests as could be universally accepted as conclusive evidence that the eye-bars proposed are available and economical. It is unsafe to attempt to reason at one leap from 6 in. x 2 in. or 10 in. x 1¼ in. eye-bars to 18 in. x 2 in. eye-bars, especially as there are available means to make and test much larger bars than have been tested.

Four months were apparently consumed by the board of experts in making investigations and tests, and yet in its final report in which it states that all doubts are removed as to the availability of nickel steel for the chains of the Manhattan bridge only the slightest mention is made of the grounds on which this conclusion is based. In fact, the report did not claim that the specifications which it stated "would be" satisfactory had been actually attained in the tests made. The substance of this final report is contained in the following extract:

> Three different manufacturing plants have manufactured and tested nickel steel bars for the purpose of this investigation.
>
> From the result of the tests submitted to us we are satisfied that material which *will meet* the requirements hereinafter outlined can be obtained for this bridge.
>
> This investigation satisfied us that a steel of the following qualities in full-sized annealed eye-bars *will be* satisfactory:
>
> | | |
> |---|---|
> | Ultimate strength, lbs. per sq. in. | 85,000 |
> | Actual elastic limit, lbs. per sq. in. | 48,000 |
> | Percentage of elongation in 18 ft. | 9 |
> | Percentage of reduction at fracture | 40 |
>
> The tests so far made would indicate that the above results can be obtained by a steel made by the open-hearth process, containing 3¼ or 3½ per cent. of nickel; containing not over 0.05 per cent. of sulphur; not over 0.06 per cent. phosphorus, if made in an acid furnace, not over 0.04 per cent. if made in a basic furnace.
>
> In our preliminary report of March 9 we reported favorably on all features relating to the design of this bridge, subject only to the uncertainty of obtaining this quality of material. This uncertainty is now removed.

If the tests warranted the conclusion it is impossible to understand why they were not fully embodied in the report. The absence of definite information regarding the tests naturally gives rise to the suspicion that they hardly warrant the conclusion reached. It is reliably understood that the specifications for nickel steel for the Blackwell's Island bridge, which are based on this report, after the first tender was received and rejected, underwent material modifications together with other features in an effort to secure on a second letting acceptable tenders for this work. Of the two tenders received at the second letting the lower was but $160,000 less than that received on the first letting despite the material changes in the specifications. The single tender received at the first letting appeared so excessive that it was emphatically stamped by the Commissioner of Bridges as being the result of "collusion and fraud"; although since the second letting he seems, without any reason which he apparently cares to make known, to have looked at the matter in a different light.

As to the result of these eye-bar tests the Commissioner of Bridges, in his several statements and communications, is wholly silent; although in a communication published in the *Engineering News*, Sept. 10, 1903, Mr. Leon S. Moisseiff, Assistant to the Commissioner, Department of Bridges, gives some information as to what was tested but no information as to the results, except that they were "satisfactory." Mr. Moisseiff states that:

> ". . . In order to test the upsetting, forging of heads and annealing, 21 full sized eye-bar tension tests were made by the Pencoyd plant of the American Bridge Co., on nickel steel eye-bars manufactured by the Carbon Steel Co. of Pittsburg, of the following sizes:
>
> 4 eye-bars, 6 x 1 in. — 6 eye-bars, 8 x 1½ in.
> 5 eye-bars, 6 x 2 in. — 6 eye-bars, 10 x 1½ in.
>
> "All these eye-bars broke in the body of the bar with very satisfactory results. In addition to these, eight full sized eye-bar tests of nickel steel were made on bars manufactured by the Carnegie Steel Co. of the sizes 6 in. x 1½ in. and 6 in. x 2 in., and tested by W. R. Webster, M. Am. Soc. C. E., whose report was duly submitted to the Board of Experts on the Manhattan bridge, and the requirements in the specifications are based on the results obtained.
>
> "In order to compare the results of nickel steel in extremely large eye-bars, two nickel steel bars were rolled at the works of Carbon Steel Co., Pittsburg, Pa., 18 in. x 2 in. by about 25 ft. long and 18 in. x 2¼ in. by 62 ft. long. . . . Test pieces were cut from different portions of these bars and gave satisfactory results."

Here is the same indulgence in hopeful generalities and the same complete disregard of the importance of actual facts in substantiating the position taken. The question naturally forces itself forward, if all these reports and statements are intended to convey convincing information why are the most important points involved persistently withheld? Why cannot the results of these full size eye-bar tests made for the Department of Bridges be given in the same manner as those for the Wabash bridge referred to before? Why were not eye-bars made and tested as large as could be manufactured and tested by existing plants and testing machines?

It is not possible to produce evidence that 18 in. x 2 in. nickel steel eye-bars with 42 in. heads cannot be manufactured, but it is clear that no adequate evidence has been produced that these can be manufactured, especially in large quantities so as to be satisfactory structurally or successful commercially. No adequate test has

been made to settle the question, and the policy of those in authority is apparently to accept these eye-bars as an attained fact on the strength of speculation and to prove the case afterwards.

There are possibilities in nickel steel that fully warrant its study and development for structural purposes, and it is to be regretted that there has not appeared to the manufacturers and users of structural steel enough promise in these possibilities, to warrant a more generous expenditure of study and money on the development of its availability for these purposes. But in view of the undeniable difficulties in making satisfactorily very large eye-bars of medium carbon steel, which is so well known because it is made by the millions of tons, it cannot properly be denied that it is an experiment to undertake to make eye-bars of a larger size than has even yet been made and of a material never yet practically applied to this use, the result of which cannot be foretold, either as to its character or as to the time it will consume. It would be of unquestionable benefit to the art of bridge building, to the manufacture of steel, and to the development of the nickel industry, if the problem of eye-bar manufacture and the applicability of nickel steel for this purpose could be worked out in an elaborate experiment. But the benefit to the City of New York, in undertaking this experiment as part of the already formidable and costly task of again spanning the East River within as short a time as possible, is not apparent. Doubtless there are manufacturers who can make nickel steel of as great or greater strength than required by the specifications. Others will be found who will undertake to make the bars of this material if a profit is reasonably assured. But should it prove impracticable to meet the requirements specified, these requirements would doubtless have to be modified in order to conform to the limitations of manufacturing methods. Otherwise no concern would bid at all. Few seem anxious to bid. It is a far reach between encouraging assurances and a contract.

Assuming it practicable to make nickel steel eye-bars as large as proposed at a cost and within the time to properly bring them in competition with wire, the superiority of eye-bar chains over wire cables has not been proved, while there is much evidence to prove the contrary. As far as can be ascertained from the reports of the board of experts and from the statements coming directly and indirectly from the Commissioner of Bridges the following are the grounds which are claimed to warrant the proposed change of plans for the Manhattan bridge.

(1) Greater rapidity and economy in erecting the eye-bar chains.

(2) Greater rigidity under partial loading.

(3) Assumed greater capacity of bridge.

(4) Greater accessibility of the parts of the chains for examination and protection.

(5) The superiority of pin connections for attaching the stiffening system to the chains instead of bands as in the case of cables.

(6) The necessity of a fire-proof floor system.

(7) The superiority of rocker-bent towers over rigid towers with roller bearings under cable saddles.

(1) COMPARATIVE COST AND SPEED OF EYE-BAR AND WIRE CABLE ERECTION.

Prior to the construction of the new East River bridge the opinion was very general, though strongly combatted by Mr. L. L. Buck, that the time required for stringing the wires of a cable would be unavoidably long, and therefore a serious objection to this form of construction. Mr. Buck had maintained that the causes for the great length of time consumed in cable making in previous cases, could by the adoption of improved methods and due diligence be greatly reduced. This view was fully borne out in the case of the Williamsburg bridge. The actual time consumed in laying the straight wires in the cables of this bridge was seven months, from Nov. 27, 1901, to June 27, 1902, including the numerous delays consequent to carrying on this class of work during the winter. The time consumed in the actual work of wrapping the cables and placing the cable bands and suspenders was something over 30 days. It is true that during this work of cable construction there were numerous and serious delays from strikes, fire, disputes as to methods of procedure, etc., but in no case can any serious delay be properly attributed to the form of construction. In its influence on similar work in the future, this experience is most important, in that it must inevitably expedite, cheapen and simplify such work.

In the case of eye-bar chains, of such proportions as are necessary in the case of the Manhattan bridge, the methods of erection are as much or more a matter of speculation than the manufacture of the eye-bars. Eye-bar chains hitherto built are comparatively so small that it is not proper to use them as applicable to this case. All those difficulties and delays invariably met with in radical departures from established practice, especially in works of great magnitude, must attend the erection of these chains. The temporary suspension bridge for erection is an essential feature of both chain and cable construction, but with some very important differences. In the case of the cables this is merely a foot bridge, with but little load to carry besides its own weight, such as the carrier ropes and their supports, the looped wires as they are carried across, the workmen, and light tools. The cables and individual strands before they are put in the cables, are of course self-supporting. In the case of the chains, the temporary bridge must carry besides its own weight, all the connecting pins 18 in. in diameter and some 6 ft. long, and a considerable number of the eye-bars themselves. Further, it must carry the necessary plant for handling the 3½ or 4-ton eye-bars and for forcing them on their 18 in. pins.

While it is impossible to give here a comparison in figures between the capacities of the temporary bridges in the two cases, it is evident that the capacity of the bridge required for the chains is many times greater than that required for the cables. This means for the former case much longer time to erect the temporary bridge and much greater cost of same.

It is understood that in order to avoid the necessity of carrying the weight of the entire chains on the temporary bridge it is proposed to connect up at first only such bars as are necessary to make the chains self-supporting, and to thread the balance of the bars on the pins after the partially constructed chains are swung clear of the temporary bridge. Just what the course of procedure in this method of erection would be is not clear. However, it can hardly be deemed unreasonable to assume that threading 50-ft. eye-bars on 18-in. pins under the conditions proposed will require novel methods difficult to perfect in advance and will be attended with troubles not readily disposed of. At the towers and anchorages these difficulties will be most formidable. In the case of wire cables, aside from the fact that the methods of manufacture and erection are so well known, the fact that their construction entails handling less than one-half the weight of metal required by any other form of construction, is of itself an advantage difficult to overcome.

(2) RIGIDITY UNDER PARTIAL LOADING.

In long span suspension bridges the highest degree of safety and endurance is not attained with minimum deflection, but with the farthest removal of maximum induced stresses from the ultimate strength, or at least from the elastic limit of the material. Under maximum loads the deflections in the original design of the Manhattan bridge will be greater than in the substitute design, but this reduction of deflection in the latter is secured at the cost of seriously reduced safety, greatly increased dead load and greatly increased cost. While I cannot go to the limit of considering the stiffening system of a suspension bridge other than a necessity, I do consider that its functions are fully performed when it keeps deflection within practical limits and without undue stresses. However, the failure of the stiffening system will not endanger the safety of the bridge, provided there is adequate strength in the cables and suspenders. Such failures have occurred repeatedly without disaster.

It should be remembered that the service of such a highway bridge as the Manhattan bridge differs greatly from that of a railroad bridge, in that the live load rarely departs materially from uniformity and it is therefore wholly unnecessary to provide stiffness to meet extraordinary cases as if they were of constant occurrence. The type of bridge proposed for the substitute design was originally conceived for the Quebec bridge with capacity for two lines of the heaviest railroad traffic, two lines of trolley cars and two highways. In this bridge a working load of 8,000 or 9,000 lbs. per lineal foot on the railroad tracks alone must be dealt with, as constantly coming on the bridge in such a manner as to produce stresses approaching the maximum, and demanding great rigidity to prevent undue deflection. The traffic on the Manhattan bridge will be similar to that on the Brooklyn bridge, which has almost no stiffening system at all, and yet has carried an enormous traffic without failure save in cases of most excessive abuse. The failures that have occurred have rather attested the powers of endurance of this type than any defect in its main features. It should be remembered that the function of the stiffening system is to care for inequality of loading and not to transfer the loads to the points of support; this function belongs to the suspenders and cables.

The matter of deflection in suspension bridges was quite fully discussed, and without marked difference of opinion in the reports of the two boards of engineers who passed upon the North River bridge proposition, and in the discussion of Mr. George S. Morison's paper on Suspension Bridges (Transactions Am. Soc. C. E., Vol. xxxvl., No. 793). In discussing this paper Major Raymond said:

> The Army Board devoted considerable attention to the question. It remarked that "the great distinction between the stable equilibrium of a suspension bridge, which cannot break down from the failure of any stiffening member, and the unstable equilibrium of a truss arch or cantilever bridge in which the failure of a member may involve the collapse of the entire bridge, ought to receive full recognition in the adoption of unit stresses and safety factors." Again, the Board remarked that "rigidity is in this case of much less importance than it is in most other kinds of bridges; indeed, it may be shown that a certain small flexibility is a positive advantage in suspension bridges;" and still again, "the Board does not doubt that within narrow limits a certain degree of flexibility is an advantage to the bridge. Deflections in a system of stable equilibrium do not impair the safety of the structure, as they do in an unstable system like an upright arch and they may exert a very beneficial influence in modifying the dynamic effect of a rapidly varying live load."

It is decidedly more important to keep the stresses due to possible working loads within safe limits, than to show a low deflection with excessive stresses under impossible loads.

(3) COMPARATIVE CAPACITY OF THE TWO DESIGNS.

In a communication to the Vice-Chairman of the Board of Aldermen, dated July 31, 1903, the Commissioner of Bridges stated that at a cost of 20 per cent. more than that of the original design, the substitute design had 80 per cent. greater capacity in the stiffening system and 40 per cent. greater capacity in the chains. He questioned the accuracy of the estimate of cost of the original design and used the cost of the Williamsburg bridge as his basis of comparison. He based his estimate on the assumed working loads of 4,500 lbs. per lineal ft. for the original design, and 8,000 lbs. per lineal ft. for the substitute design. But he qualifies his statement by the uncertain statement that "the working load is, however, not the only criterion."

The actual capacity of a bridge should not be confused with its assumed working load, which is largely a matter of assumption and has only partial influence on its capacity. Aside from the working load the capacity of a bridge is dependent upon the dead load, the strength of the material in the structure and the allowable unit stresses; or in other words upon the total load carried and the factor of safety. It has always been a generally recognized rule in designing suspension bridges that safety, economy, durability and proper provision for the future, demand that a large factor of safety be provided in the cables and suspenders. This provision has permitted the live load of suspension bridges to be increased far beyond what was originally contemplated for them, despite grave faults in other features of the design. The Brooklyn bridge and Niagara railroad suspension bridge are striking examples of this. The principle was adopted in the design of the Williamsburg bridge and also in the original design of the Manhattan bridge.

The Commissioner of Bridges in the substitute design has not only departed from this principle, but has adopted for the chains a smaller factor of safety than has heretofore been considered proper for the stiffening system, and still smaller than is counted proper for either highway or railroad bridges of truss, arch or cantilever types.

The proper comparison of the capacities of the two designs is a simple matter of arithmetic. The factor of safety is based on the elastic limit as it should be. However, basing it on the ultimate strength would not materially change the results.

	Original design. Wire cables. Lbs. per sq. in.	Substitute design. Eye-bars. Lbs. per sq. in.
Minimum elastic limit	180,000	48,000
Allowable unit stress for combined live and dead loads	50,000	30,000
Margin of safety between allowable unit stresses and elastic limit	130,000	18,000
Factor of safety	3.6	1.6

The corresponding factor of safety for truss members in ordinary bridges ranges from 2 to 2.5.

It has not been demonstrated nor is it self evident why in the vital member of such a bridge the factor of safety should be so reduced. Especially is the warrant for such reduction inconceivable in view of the fact that this member is to be made of eye-bars of a material and size hitherto unknown to bridge construction. The factor of safety of the straight wire cables is more than twice that of the eye-bar chains, and, although it would be wholly impracticable to bring that of the latter up to 3.6, it would be nothing short of a serious risk to make it less than 2, and nothing more than safe practice to make it 2.5 under working load.

To arrive at the actual capacities of the cables and chains in the two designs, it is necessary to take into account the assumed live loads and the dead loads in each case. The assumed live load for the cables of the original design is 5,700 lbs. per lineal ft., and the dead load about 16,000 lbs. per lineal ft., a total of 21,700 lbs. The working live load of the substitute design is 8,000 lbs. per lineal ft., and the dead load (estimated) about 24,000 lbs. per lineal ft., making a total of 32,000 lbs. Therefore if the factor of safety in the former case is made the same as in the latter, the actual capacity of the cables of the original design would be given by the proportion $1.6 : 3.6 :: 21{,}700 : \times = 48{,}800$ lbs. per lineal ft. Therefore the cables have $\frac{48{,}800 - 32{,}000}{32{,}000} = 50$ per cent. greater capacity than the chains, instead of the chains having 40 per cent. greater capacity than the cables.

In comparing the stiffening systems of the two designs on a similar basis, the contrast while not so great as in the case of the cables, is quite different from what is represented by the Commissioner of Bridges. In this case, of course, only the live loads are to be considered.

	Structural steel in trusses. Original design. Lbs. per sq. in.	Substitute design. Lbs. per sq. in.
Minimum elastic limit	40,000	30,000
Allowable unit stress under working load	20,000	20,000
Margin of safety between allowable unit stress and elastic limit	20,000	10,000
Factor of safety	2	1.5

The factor of safety in the substitute design is thus reduced 25 per cent., and the margin of safety 50 per cent. Or if the factor of safety adopted in the substitute design were used in the original design, the live load could be increased to 6,000 lbs. per lineal ft. as given by the proportion $1.5 : 2.0 :: 4{,}500 : \times = 6{,}000$ lbs. per lineal ft.

Thus on a proper basis of comparison the capacity of the stiffening system of the original design is less than that of the substitute design by $\frac{8{,}000 - 6{,}000}{8{,}000} = 25$ per cent. Of course the foregoing is merely a comparison of capacities and has no bearing on the question of what should be assumed for the working and emergency live loads for this bridge.

In fixing the live loads of the original design the Will-

iamsburg bridge was taken as a basis of the assumptions, and the observed traffic on the Brooklyn bridge was used for purposes of confirmation. The working load was based on conditions likely to occur at times, and the emergency load was based on conditions that might possibly occur under very extraordinary congestion of traffic, the factor of safety being sufficient to provide for conditions more severe than those that could occur in the legitimate use of the bridge. While it is possible that the loads assumed in the original design are not as great as should be provided for in the light of growing demands if heavy auto-trucks and heavier cars are to be used; nevertheless additional capacity can be provided more readily and at less cost in the original design than in the substitute design. A very careful study, however, of actual traffic conditions, and the assumptions forming the basis of loadings taken for the substitute design shows a scant relationship between the two.

(4) ACCESSIBILITY FOR PROTECTION AND INSPECTION.

The Board of Experts in their preliminary report said "the chains have decided advantages in accessibility of parts for inspection and protection." The protection referred to is presumably painting. This statement has been made also by the Commissioner of Bridges. In neither case have the reasons been given. In the case of chains the greater part of the surfaces of the component bars will be accessible, though not readily so, for inspection and painting. These surfaces will be also very readily accessible to the rather severe action of the surrounding salt air. The parts of the chain where trouble is most likely to appear, on account of motion under moving load and temperature changes—that is the surfaces of the eye-bar heads in contact with each other and the pins—are wholly inaccessible. The amount of surface requiring inspection and painting is about 10 times greater in an eye-bar chain than in a cable and is decidedly more difficult to inspect and paint.

A wire cable is, as far as inspection and painting are concerned, a solid cylinder of steel. It is true that the interior wires are not accessible for inspection, nor are the interior fibers of an 18 in. x 2 in. eye-bar. The necessity for inspection is no greater in the former than in the latter case.

The evidence is ample that there is no necessity for inspecting a properly constructed wire cable inside the wrapping, as deterioration from rust or other cause does not occur in the body of a cable. When it occurs at all from protracted neglect or abuse, it begins at the surface. No wire cable has ever suffered appreciable deterioration save as the result of conditions, which cannot properly be assumed to exist in the light of present knowledge. When the cables of the Niagara railroad suspension bridge were taken down after 50 years of service the wires were as sound as when first put in place, although not galvanized. Some of the wires in the outer layers of these cables were at one time found to be badly rusted at the points where the cables entered the anchorages, due to the fact that the cables at these points were bedded in concrete in such a manner as to make the breaking of the bond between the cables and concrete, and the consequent entrance of water and rusting, inevitable. The damage, however, was confined to the outer wires and was readily repaired and a repetition of the trouble fully guarded against.

The old Lewiston and Queenston bridge was built in 1850, and its suspended superstructure was destroyed in 1864. The small straight wire cables hung in place without care until cut down in 1898 to make way for the new bridge and the straight wires were then found to be perfectly sound and free from rust, except in some places where the wrapping had been omitted or torn away. These wires were not galvanized. The galvanized wires in the cables of the New York and Brooklyn bridge are in practically a state of perfect preservation after 20 years of service.

The old Sixth street suspension bridge at Pittsburg has been cited by the Commissioner of Bridges (*Engineering News*, Aug. 13, 1903), as a case where "general weakness and progressive corrosion of the iron wire cables was the cause of its reconstruction." This half truth loses much of its force as an argument when the other half is known, which is, that the weakening was due to excessive overloading not contemplated in designing the bridge, and to an excess of neglect and abuse that should never have to be provided for; where any degree of rational care is to be exercised. An examination to-day of any of the Pittsburg city bridges irrespective of type, will doubtless show the same well developed "progressive corrosion" which must in time reduce them to the same necessity of reconstruction.

PIN CONNECTIONS AND SUSPENDER BANDS.

It has been claimed that suspender saddles or bands cannot grip the cables tightly enough to prevent slipping on the steep part of the cables. This slipping has occurred in some cases, notably on the Brooklyn bridge, but neither in this case nor in others has the slipping been such as to cause any trouble. Further an examination of the form of cable bands which have been known to slip will promptly show that they have only a slight and uncertain grip on the cable. (See Fig. 1.) The only means of gripping the cable is by screwing up the pin carrying the supender, which is limited in its gripping action.

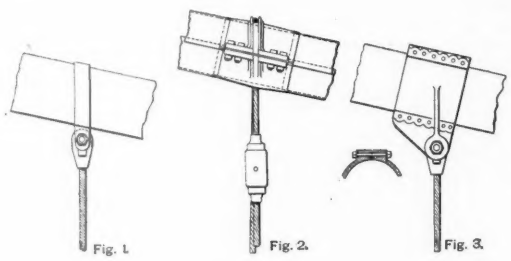


Fig. 1. Fig. 2. Fig. 3.

Compare this, which has certainly served reasonably well, with the suspender saddles of the Williamsburg bridge (Fig. 2), or the suspender bands proposed in the original design for the Manhattan bridge (Fig. 3), and it can be readily seen that the very positive grip furnished by the several bolts in these cases must make the connection of the suspender to the cable as positive as practical conditions can demand.

(6) FIRE-PROOF FLOOR SYSTEM.

In preparing plans for the original design of the Manhattan bridge, the matter of a floor more permanent and fire-proof than wood, was fully considered, with a determination of adopting such, if any could be found practicable. Buckle plates and asphalt were decided to be impracticable on account of the frequent difficulty encountered in maintaining asphalt on smaller bridges, and on account of the candid acknowledgment of the experts of the leading asphalt company in New York, that, in order to insure such endurance of the asphalt as to render its adoption at all feasible, the weight of beams and buckle plates under the flooring would have to be so great as to render it wholly impracticable in spans of such great length. While a timber floor is not fire-proof and is much less durable than could be desired under heavy traffic it is easily protected against fire and has distinct advantages, such as low first cost, ease and cheapness of renewal, sureness of footing for horses, and the greatest degree of lightness for requisite stiffness and strength. In the original design for the Manhattan bridge it was proposed to use on the roadways a 4-in. creosoted underflooring and a 2-in. wearing surface. Only the wearing surface has to be renewed, save at long intervals, as properly treated creosoted timber will last at least 20 years. The interest on the extra cost of a buckle plate and asphalt floor and of the additional material necessary to carry this heavier floor will several times repay the cost of maintaining a wooden floor in excellent condition. The great trouble with most wooden floors is that they are not renewed often enough.

As to risk from fire, this seems hardly more serious than that from earthquakes when it is considered how open and accessible the floor is, how thorough is the protection on land by the fire limit regulations, and how thoroughly and constantly the bridge and all its surroundings on land and water are patrolled. Asphalt to wear properly under heavy traffic must have a solid and unyielding foundation. Buckle plates, ⅜ in. thick, on stringers 5 ft. apart center to center, do not form an adequately rigid foundation to insure reasonable durability of the asphalt under heavy traffic. This has been shown on some of the Harlem bridges where traffic is comparatively light, and quite generally in cases of heavy traffic.

(7) ROCKER-BENT TOWERS.

The fact that there are in the substitute design only four legs instead of eight in each tower, will call for such enormous sections that these will probably have to be built up in place, instead of being manufactured at the shops in sections, or else they will require the handling of sections unprecedented in weight and bulk. The tower will not be self-supporting but will be in a state of unstable equilibrium, dependent upon temporary support during erection and the attachment of the chains after completion of the bridge. While the erection of the tower itself may not present more difficulties than can be overcome by an adequate expenditure of time and money, there is much uncertainty as to what conditions it will have to meet during the erection of the temporary bridge and the chains. It cannot be other than difficult to maintain in a rocker-bent of such proportions, both the fixedness and the adjustability required to meet the great variations of loading that must occur during the erection of the chains.

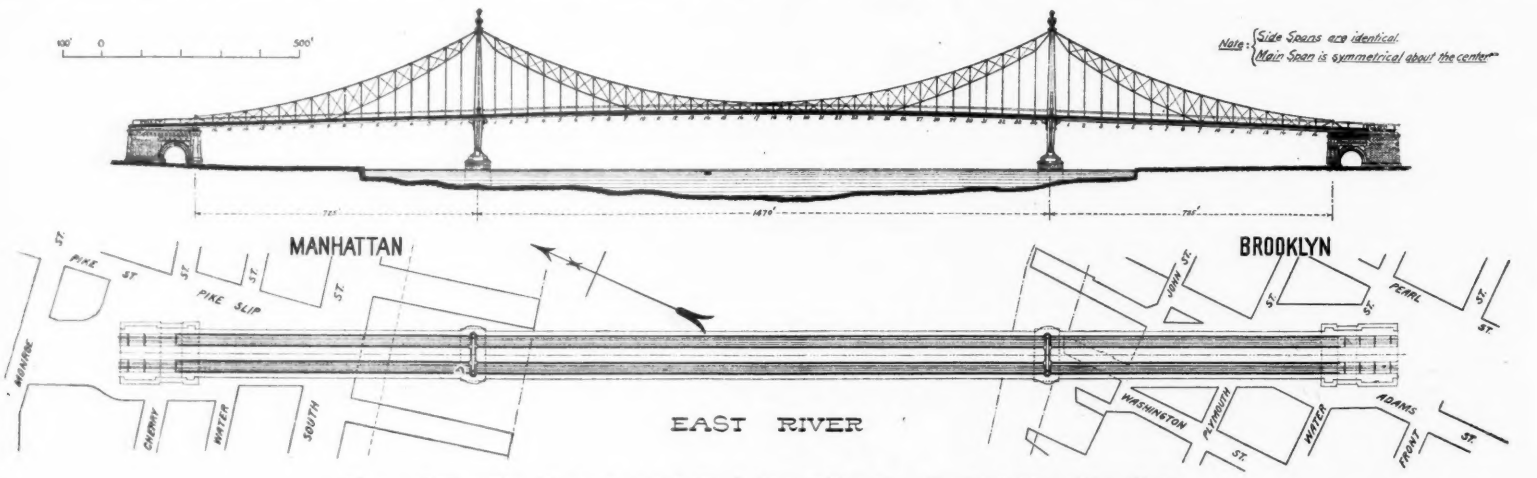
The proposition of erecting both the towers and chains is one that cannot be fully discussed here, as the methods to be employed are yet so wholly unknown and there is such complete absence of precedent by which to judge it. However, it cannot fairly be counted other than an elaborate experiment with the initial work still ahead. The action of the hinged joints both at top and bottom of the tower after the bridge is completed, and whether or not there will be motion on the pins and how much, can hardly be determined beforehand. However, there must be a much greater tendency to motion than on the pins of an ordinary truss bridge, where but very slight motion is sufficient to cause wear between pin and pinhole, especially where very high bearing pressures exist. If the trussing of the chains is to be as rigid as appears from the slight deflections claimed for the design, the motion will be largely concentrated at the pins at the center of the main span and at the towers; and while it is not certain that it will cause wear, there are grounds for apprehending it.

R. S. BUCK,
Chief Engineer, Dominion Bridge Company.

The Manhattan Bridge Over the East River, New York.

The Commissioner of Bridges of the City of New York has prepared plans for another bridge over the East River, connecting the Borough of Brooklyn with the Borough of New York. It is known as Bridge No. 3, or the Manhattan Bridge, and is located between the Brooklyn Bridge and the nearly completed Williamsburg Bridge about a half a mile above the former. The original plans for this bridge prepared by R. S. Buck, Chief Engineer under Bridge Commissioner Shea, called for a wire-cable suspension bridge, with fixed steel towers, but the present Commissioner, Mr. Gustav Lindenthal, on taking office two years ago began the substitute design now shown, which consists of an eye-bar cable suspension span with stiffening truss and rocking towers.

The general appearance of the bridge and its location are shown in the plan and elevation. It consists of one channel span 1,470 ft. long and two identical shore spans each 725 ft. long. Four cables are used consisting of banks of nickel steel eye-bars with pin connections and stiffened with an auxiliary truss of which the cables form the top chords. The towers rest on rollers under each leg and are free to oscillate in line with the bridge, to equalize the effects of local overloading and expansion due to changes in temperature. The cross section of the bridge shows the arrangement of surface and elevated car tracks and roadways. The two inside cables are spaced 40 ft. apart and the two outside cables are spaced 28 ft. further out on each side. On each side of the



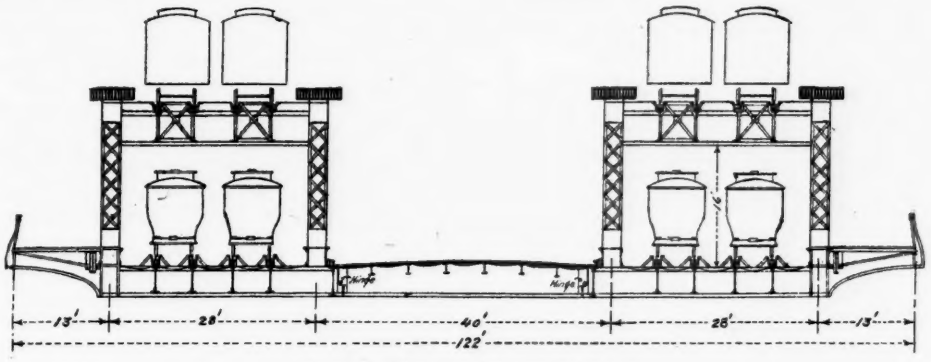
Plan and Elevation of the Proposed Manhattan Bridge Over the East River, New York.

bridge there will be two tracks for surface cars and immediately above these on an upper deck, two tracks for elevated cars. The sidewalks, 13 ft. wide, are outside of the tracks on the level with the roadway, which is 40 ft. wide and occupies the center of the bridge. There is 16 ft. headroom between the floor of the street car tracks and the floor-beams of the elevated structure overhead.

The channel span is divided into 35 panels, each 42

ft. long. The stiffening truss is composed of the main cables for a top chord and compression members in the posts and bottom chord with diagonal braces in tension from each panel point. In the panel next to the towers the bottom chord is brought up to the cable saddles and towers and bridge the bearings will be wedged up to prevent any movement.

The details of the cable saddles on the top of the towers are shown in the drawings. Nineteen plates, 72 in. x $1^{11}/_{16}$ in. x 11 ft. 3 in. are packed between the eye-

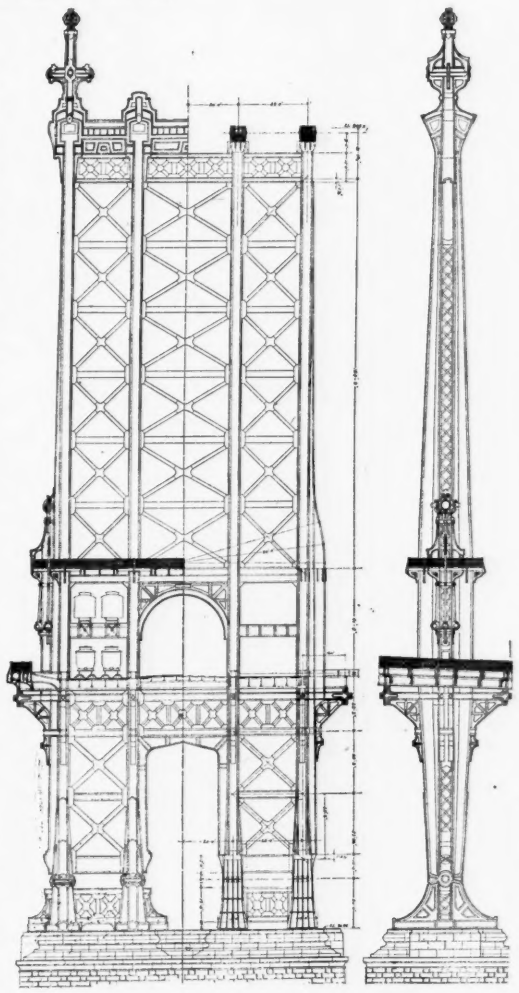


Cross-Section of Bridge at Roadway.

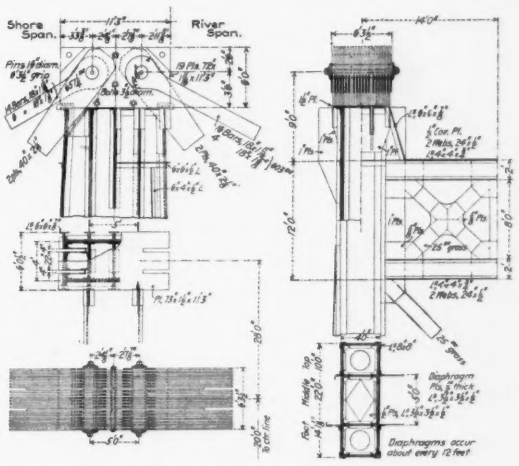
the diagonals omitted. At the first panel the vertical member of the stiffening truss is 31 ft. long, and at the tenth panel where the bottom chord connects with the floor framing the vertical member is 58 ft. long. At the center of the bridge the cables are 22 ft. above the floor. The bottom chord is 26 in. deep between panels 1 to 10 and 25 to 35. The suspenders between panels 1 to 6 and 29 to 35 are 12 in. x 1¼ in. eye-bars, latticed for stiffness. In the shore spans the stiffening truss is not symmetrical with the main span truss, being carried down to the floor framing at the ninth panel, although the arrangement and function of the members is the same. The spans are divided into 17 panels, each 42.65 ft. long. The vertical post in the stiffening truss at panel 1, is 33 ft. long, and at panel 9, is 65.7 ft. long. The suspenders between panels 1 to 5 are similar to those in the main span, being 12 in. x 1¼ in. eye-bars, pin-connected to the floor system.

The main floor system is built up with plate girder floor-beams 49 in. deep under the car tracks and 45¾ in. deep under the roadway. These beams are spaced at each panel point and the buckle-plate floor is carried on I-beam stringers extending between the beams. To provide flexibility of the whole floor system, the main floor-beams are made in three pieces, and hinged together at the edge of the center roadway on each side. The sidewalks are to be of concrete and will be supported by a plate girder stringer on the outside, 36 in. deep, extending between the main floor-beams. The floor-beams for this portion of the floor system will be 7-in., 17.5-lb. I-beams, spaced 4.2 ft. apart. Under the street car tracks the four stringers are plate girders, 43 in. deep. Under the roadway two extra plate girder floor-beams are put in and the stringers are made of 15-in., 42-lb. I-beams. The elevated tracks will be carried on 54-in. plate girder beams between the posts at each panel point, and the four stringers are to be 48-in. girders, one under each rail.

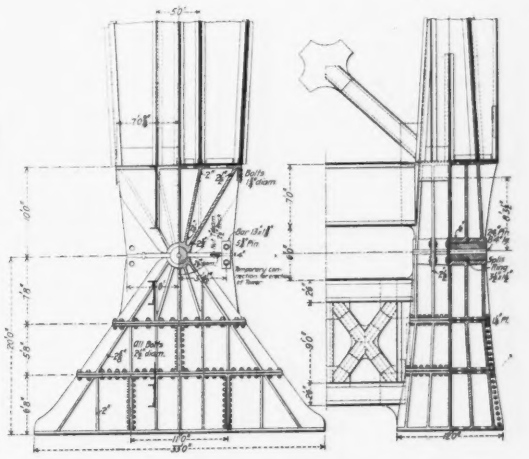
The two towers, shown in front and side elevation, harmonize with the graceful lines of the cables and stiffening truss. They consist of four built-up posts, each made in two parts, the whole structure being braced with lattice work and diagonals. The exterior will be ornamental with a light steel shell. Resting on each of the masonry piers which are now being built, are four cast bed plates built up in sections and bolted together. These have a bearing on the bottom of 33 ft. x 12 ft.



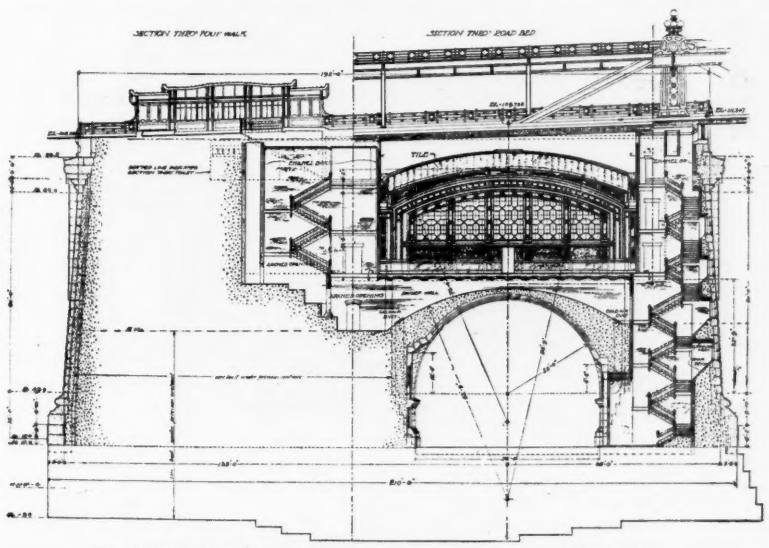
Front and Side Elevations of Towers.



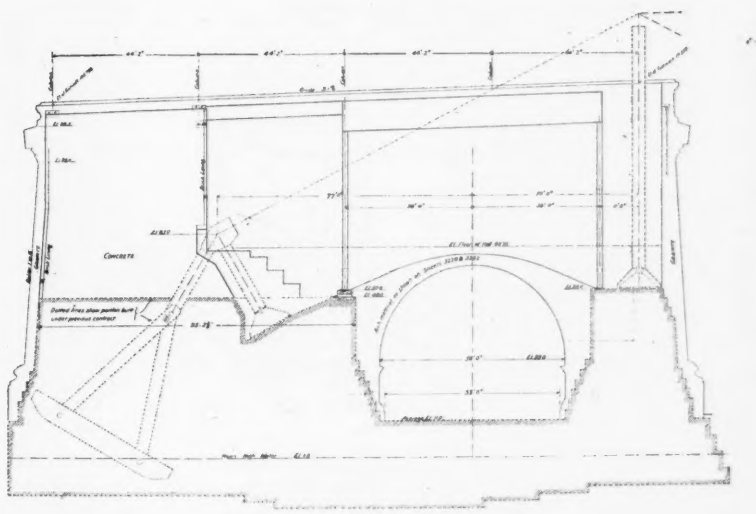
Detail of Top of Tower.



Detail of Rocker Bearing at Base of Tower.



Longitudinal Section Through Anchorage and Assembly Hall.



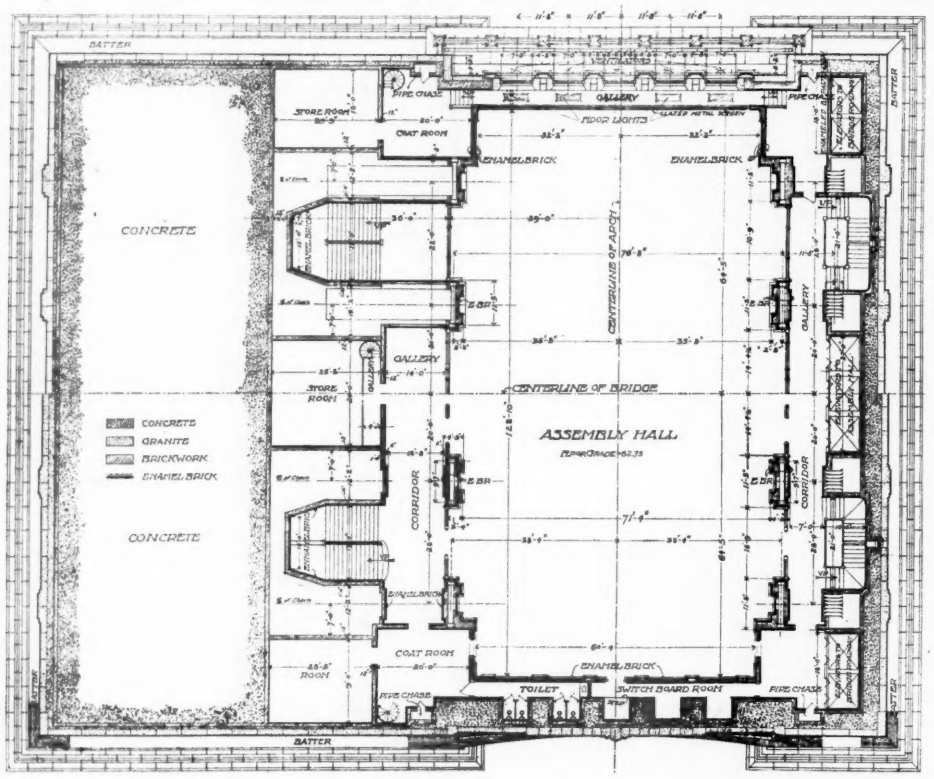
Side Elevation of Anchorage.

and are heavily ribbed inside and out. Each bed plate carries a hollow steel roller, 8 ft. 4 in. long and 24 in. in diameter, on which the bearings on the legs of the towers rest. These bearings have an area on top, 11 ft. x 14 ft. 1½ in., and are likewise heavily ribbed castings, made, however, in one piece. At a distance of 6 ft. on each side of the pin the opening between the top and bottom bearings is 4 in. During the construction of the bars and rest on edge on a 1½-in. plate on top of each tower leg. The pins holding the plates and eye-bars together are 16 in. in diameter and 6 ft. 3½ in. long, inside plates washers. Six 3½-in. bolts are also used to tie the pins together. From the top of the piers to mean high water is 31.46 ft. The rocker pins are 51.46 ft. above m.h.w., the roadway at the towers, 132.5 ft., and the cable pins, 348.5 ft. above m.h.w. The chord of the truss in the floor system at the center of the span is 143.8 ft. above mean high water.

The anchorages are shown in longitudinal section. The foundations for these have already been built, as shown by the cross-hatched portion. They will be of solid concrete with granite facing, and in the portion below the water line, 12 in. x 12 in. timbers have been bedded to take up some of the tension which will exist at that point. The vertical strut is supported on a rocker bearing, as is also the inclined strut at the back of the anchorage. In each anchorage will be built a large assembly hall directly over the roadway arch. This is shown in plan and longitudinal section. It will be 128 ft. 10 in. long by 71 ft. 4 in. wide, and will be reached from the street level and the bridge sidewalks by elevators and stairways. Much, otherwise, waste room is thus made available for public purposes. The halls will be lighted from the sides by large ornamental glass windows shown in the section. Toilet and coat rooms are provided and the other rooms for storage.

The specifications for the steel work are practically the same as those for the Blackwell's Island Bridge, described in the *Railroad Gazette*, August 28. The stiffening truss will be of nickel steel of a slightly different composition from the main cable eye-bars, and the specifications for it have not yet been given out. For the main cables, however, the specifications are the same as for the nickel steel eye-bars in the other bridge. The chemical requirements are, phosphorus less than .04 per cent. for basic steel and .06 per cent. for acid steel, sulphur, less than .05 per cent., and nickel, 3.5 per cent.,

minimum. The physical requirements for full sized eye-bars of nickel steel, annealed, are 85,000 lbs. ultimate strength, 48,000 lbs. elastic limit, 9 per cent. elongation in 18 ft., including fracture, and 40 per cent. reduction of area. The bar must bend cold in the neck without fracture, 90 degs. around a pin with diameter equal to two and one-half times the thickness of the bar. The structural steel is to have an ultimate strength of 60,000 lbs. in the test piece and 30,000 lbs. elastic limit with 22 per cent. in 2 in. The eye-bars in the main cable are 18 in. wide and vary in thickness from 1½ in. to 2 in. and have heads 44 in. in diameter with a pin hole, 16 in. in diameter.



Plan of Assembly Hall in the Anchorage.

The Washington Union Station.

In February, 1901, the long-discussed railroad terminal problem in Washington, D. C., reached what was supposed to be a final solution. Congress authorized the Pennsylvania Railroad to occupy an enlarged site, enclosing its present location across the Mall at Sixth street southwest, and at the same time authorized the Baltimore & Ohio to occupy a site at C street and Delaware avenue, somewhat nearer the Capitol than its present location.

A month after the passage of this act, the American Institute of Architects, acting on the initiative of the late Senator McMillan, appointed a commission to prepare a general plan for the beautifying and developing of the city of Washington and its outlying parks. This Park Commission, consisting of D. H. Burnham, Chairman, and C. F. McKim, Augustus St. Gaudens and Fred. Law Olmsted, Jr., had hardly begun its task when the fact became evident that no adequate treatment of the capital park system was possible without removing the railroad tracks and stations from the sites recently authorized by Congress.

The location of the Pennsylvania Railroad across the Mall would forever prevent the creation of General Washington's great boulevard approach from the Monument to the Capitol. The Baltimore & Ohio site on Capitol Hill at C street was scarcely less objectionable, since it brought an active commercial center within one square of the Capitol, placed a great train shed across Massachusetts avenue, to the permanent disfigurement of that beautiful avenue, and at the same time provided insufficient access to the station itself.

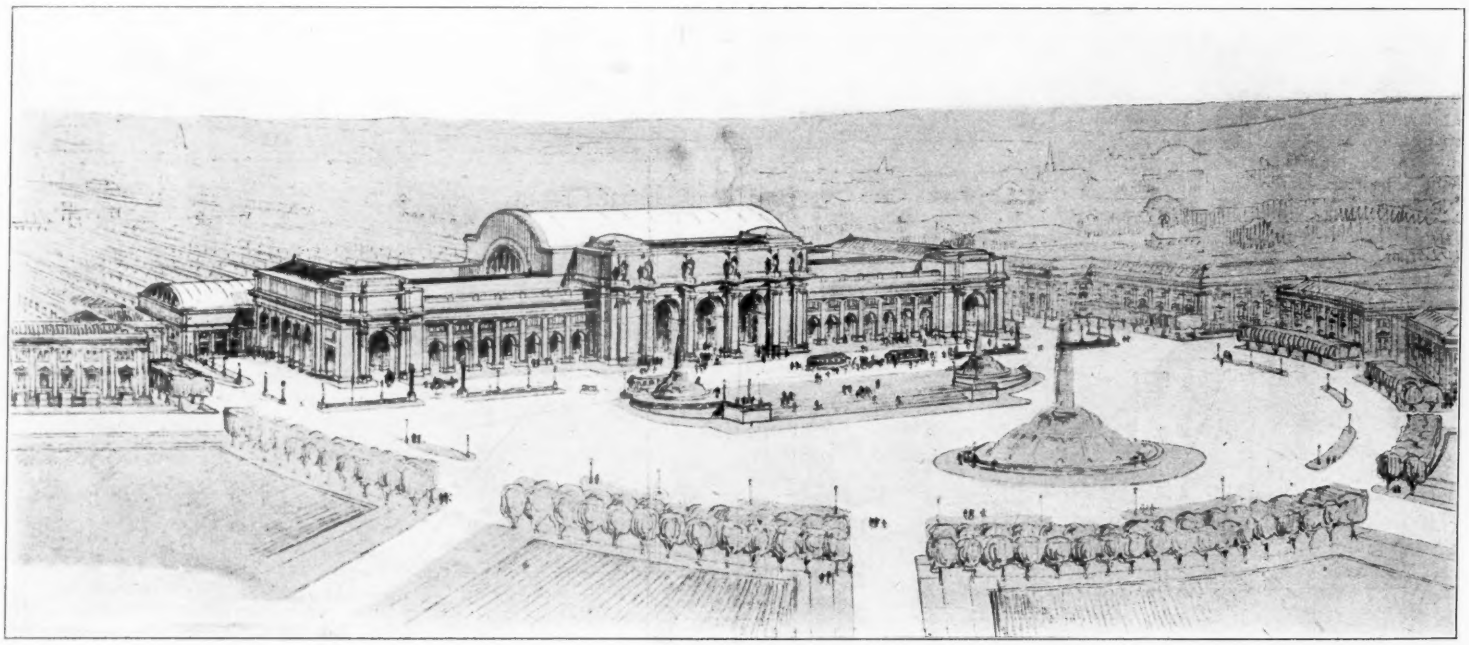
As soon as these facts were made clear, President Cassatt, of the Pennsylvania, and President Loree, of the Baltimore & Ohio, after careful consideration, agreed to meet the desire of the Park Commission in any arrangement consistent with the interests of their stockholders. The site at the intersection of Delaware and Massachusetts avenues was found to meet all conditions of utility and beauty and was finally authorized by act of Congress in February, 1903, which provided also that the terminal station should cost not less than $4,000,000, that it should be monumental in character, and that the plans should be subject to the approval of the Commissioners of the District of Columbia. The act authorized the railroads to condemn land for the terminal within a specified area in this locality, with the restriction that space on the westerly side of the station should be dedicated by the railroads to the District of Columbia, sufficient for a street not less than 40 ft. wide. Such land as was needed for yards, switches, shops, etc., outside the city limits, was to be taken when required, and connections built with the tracks on Delaware avenue, but it was specified that roundhouses, shops, etc., should be located as designated on plans approved by the District of Columbia Commissioners, and filed in the office of the Engineer Commission.

The Commissioners were authorized to close such portions of streets and avenues as might be required, except that H and K streets were to be carried under the terminal, and it was prescribed that a circle or plaza be laid out at the intersection of Massachusetts and Delaware avenues, and that streets should be laid out leading to the plaza. Damages to adjacent property owners resulting from the grade changes authorized are recoverable against the District of Columbia, but half of the expense occasioned by damage suits of this character will be refunded to the District by the United States. The property is to be taxed by the District like any other property, but as if the terminal had been built without the use of viaducts, bridges, retaining walls, and similar structures to take it off grade, and no extra valuation is allowed upon structures designed for this purpose.

The new site, although involving serious changes of street grades, is in every other respect an ideal one, being sufficiently near the business center (F and Ninth streets), while its tracks of approach affect only a small and relatively unimportant quarter of the town. The plaza referred to is 500 ft. wide by about 1,000 ft. long, and into this space come nine distinct streets, three of which are new and two are old streets whose directions have been slightly altered for a short distance by way of adjustment to the plaza. The station thus lies at the center of just such a system of radiating avenues as would have been provided for it in General Washington's original plan of more than a century ago, had the railroad station been at that time, as now, the one gateway to the city. Through these converging avenues large bodies of people can leave or enter the station without difficulty, while the plaza, with ample space for massing troops and spectators, affords adequate space for those public ceremonials that take place in front of the gateway of a city.

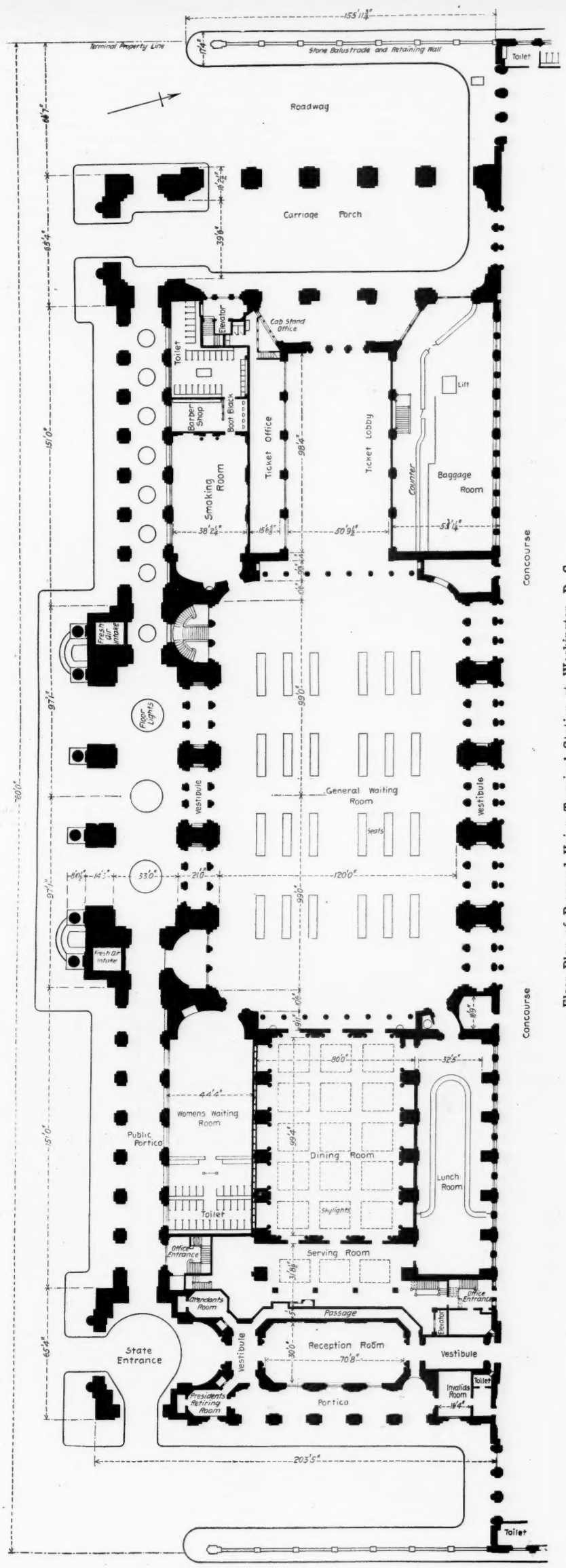
The station faces directly toward the dome over the center of the halls of Congress, half a mile distant, and will be treated in an architectural style in keeping with its character as the vestibule of the capital. A freely interpreted classic may be said to have become the recognized architecture for public buildings in Washington, and it is in view of the function of the new Union Station as the one gateway of the capital that its architectural motives have been drawn from the triumphal arches of Rome. The plaza itself, sloping gently away from the station, will be decorated with balustrades and fountains, and a terrace separating it from the fore-court, about 100 ft. wide, surrounding the building itself.

The station building proper is 620 ft. long and from 65 to 120 ft. high, and will probably be built of white marble or granite. The three entrance arches, 50 ft. high, far exceed in scale their Roman prototypes. These central doorways lead into a vaulted open-air vestibule and thence into the main waiting room. The 40-ft. arches of the end pavilions are both carriage entrances. The one toward the east is for official use, and leads to a suite of apartments exclusively for the President and the guests of the nation. The central vestibule and end pavilions are connected by an open-air portico or loggia with railroad offices in the second story above. The portico and the vestibules together constitute a continuous covered porch running along the front of the entire building.



Proposed Union Terminal Station and Plaza, Washington, D. C.

The general waiting room, with a clear width of 130 ft. and length of 220 ft., is covered by a Roman barrel vault 90 ft. high, and decorated with sunken coffers or panels. It is lighted by a semi-circular window 75 ft. in diameter at each end, and by five semi-circular windows of 30 ft. diameter on each side. Around this hall are grouped the dining room, lunch room, telephone, telegraph, parcel room, smoking room and women's waiting room, while the ticket offices and baggage room are on opposite sides of a lobby 50 ft. wide and 58 ft. high, opening directly from the waiting room. While virtually forming



Floor Plan of Proposed Union Terminal Station at Washington, D. C.

part of the waiting room, the ticket and baggage lobby serves also as a passageway for entrance to or exit from the carriage porch. This close grouping of baggage, tickets and carriage porch is an unusual arrangement in larger American stations, and it will be convenient in operation, permitting the belated passenger to buy tickets and check baggage with the utmost despatch. It has been made possible by the ingenious device of a double-deck baggage room, whereby the passenger, standing in a gallery on the waiting room level, is able to look down into an extensive baggage room on a somewhat lower level. Owing to differences in street grades which permit carriages to approach either main or basement floor, baggage will be delivered by wagon on the low level baggage room floor, whence, after checking in plain view of the passenger, it can be at once distributed on automobile trucks through low level runways, beneath the tracks, to elevators at heads of trains. In this way conflict between passenger and baggage currents is avoided, and baggage is delivered to trains with only one use of elevator service. There is no lost motion or lost time. The principle of avoiding conflict between baggage and passengers has been further carried out by providing independent train platforms devoted exclusively to the handling of baggage.

The smoking room and women's waiting room will be large, cheerful apartments, 30 by 85 ft., 28 ft. high, with windows looking toward the plaza.

The dining room, 80 by 100, 35 ft. high, will be treated in Pompeian style. Its kitchen, for the sake of preventing odors, will be in the second story.

The passenger concourse or train lobby is 130 ft. wide, 760 ft. long, and covered by an arched ceiling in a single span, decorated with panels, part of which transmit the light. As the figures indicate, this hall far exceeds in size anything ever built for a similar purpose, and is intended to be equal to any demands. The concourse is divided by the usual fence so as to allow a width of 85 ft. for handling the outgoing passengers, and a width of 35 ft. between fence and tracks for handling passengers arriving on trains. The concourse opens into the waiting room by 15 doors, and in addition it has an exit to the carriage porch and several others opening directly on the plaza.

There are in all 29 tracks, of which 18 are "stub" tracks on the same level as the waiting room, and constitute a "terminal" station. The remaining 11 tracks are depressed 20 ft. below the waiting room or street level, and six of them continue under the building into a tunnel leading southward, and constitute a through station. With the exception of the stairs leading to the depressed tracks, there are no steps anywhere in the station. Five of the depressed tracks are to be used for handling United States mail and for storage until future expansion makes necessary their utilization for passenger service.

The station will have no large span train sheds. An enormous train-shed roof so near the Capitol would dwarf the dome of the most notable building in Washington and mar the beauty of the city, and in a climate as mild as that of Washington it is believed that umbrella sheds will offer the most satisfactory solution of the problem.

A number of minor necessities not commonly provided for have been taken care of. An invalids' room is located on the passenger concourse, so as to be immediately accessible from the trains, and is provided with all conveniences. There will also be offices for a resident physician. Several mortuary chambers, for the use of people accompanying the remains of relatives or friends, are so located that a hearse or carriage can approach or leave without coming in contact with the public services.

For the convenience of business men or tourists desiring to spend only one day in Washington, comfortable dressing rooms with baths have been provided, and in connection with them a Turkish bath with swimming pool.

The upper floors will contain a number of offices for the usual operating force of railroad employees, and in addition will include reading rooms, card rooms, library and baths for the use of trainmen, besides quarters for a railroad branch of the Y. M. C. A. There will be bunk rooms for 100 men, and the policy of the terminal company will be to induce as many employees as possible to live at the station. To this end, everything possible will be done for their comfort.

The railroad approach to the station from the north will be along the present Baltimore & Ohio right of way, down Delaware avenue, on a masonry viaduct over all cross streets inside city limits. From the present Pennsylvania Railroad tracks south of the Capitol, the approach to the station will be through a tunnel passing under Capitol Hill, First street northeast and the new plaza, and finally into the station on the lower level. The tunnel will pass between the Capitol and the Congressional Library and be about 56 ft. below the summit of Capitol Hill.

The cost of the entire improvement will be about $14,000,000. The government gives $3,000,000 as its contribution toward the expense of abolishing grade crossings, and, in addition, shares with the District of Columbia the cost of building the new plaza and establishing the new streets, for which work the estimates amount to $1,600,000. The contract for building the station has been let to the Thompson-Starrett Construction Co., and we are indebted to that company, to D. H. Burnham, the architect, and to the Baltimore & Ohio Railroad for information and drawings.

The first exports of Siberian beef to Germany arrived in Berlin last October. There are not many cattle in Siberia, according to American notions, but there is room for more.

The First Bulletin of the Pennsylvania Railroad's Testing Plant at St. Louis.

The Pennsylvania Railroad has issued the first bulletin describing the work to be carried on with the locomotive testing plant which is to be installed at the Louisiana Purchase Exposition at St. Louis in 1904. The history of the organization of the Advisory Committee is given in detail in the introduction, with copies of the letter addressed to the Master Mechanics' Association and to the American Society of Mechanical Engineers, and the resolutions which both of these bodies passed in accepting the invitation to participate in the tests.

The Advisory Committee consists of Messrs. J. J. Turner, Theo. N. Ely, F. D. Casanave and E. D. Nelson, for the Pennsylvania Railroad; Mr. Willard A. Smith, Chief of the Department of Transportation, for the Exposition; Messrs. W. F. M. Goss, E. M. Herr and J. E. Sague, for the American Society of Mechanical Engineers; and Messrs. F. H. Clark, C. H. Quereau and H. H. Vaughan, for the Master Mechanics' Association. The officers are F. D. Casanave, Special Agent; W. F. M. Goss, Chairman of the Advisory Committee, and H. H. Vaughan, Secretary of the Committee. These officers were elected at a formal meeting of the joint committees at Saratoga, following the annual conventions of both societies in June. The committee has held a number of meetings and formulated complete plans for carrying out the tests next year. This first bulletin gives the plan and scope of the work in such an accurate and complete manner that it is printed in full below. Further bulletins issued from time to time will give the results of the work as it is being carried on.

PLAN AND SCOPE.

The Pennsylvania Railroad will design and cause to be constructed a suitable plant for testing locomotives, and, in co-operation with the Department of Transportation Exhibits, will install the same at St. Louis. The plant will be ready for preliminary running by the first of March next, and in perfect running condition by the first of May, at which time formal work will commence. The purpose of the whole work is to be comprehensive, and the endeavor will be to determine by the use of locomotives presenting different characteristics, the effect of the latter upon the economic performance, and the limits of the tractive power and boiler capacities.

The Pennsylvania Railroad will organize and maintain, under the direction of its Engineer of Tests, a staff of laboratory attendants and computors, to the end that the plant and the locomotives thereon may be safely and properly operated and the experimental data promptly handled. It will also provide supplies of fuel and oil, and will meet all other fixed charges incident to the progress of the work.

The Pennsylvania Railroad, having called to its aid an Advisory Committee to assist in all matters of scientific interest, will in consultation with this Committee make selection of locomotives to be tested, determine conditions under which tests are to be run, specify as to the observations to be taken and the methods to be employed, and determine the manner in which the data shall be handled and the form in which the final results shall be presented.

The Advisory Committee. While the communication of the Pennsylvania Railroad, in response to which the members of this committee were appointed, clearly contemplates additions to the membership of the committee, those already appointed have organized, and have been required to act in formulating the provisions of this programme. To avoid confusion, therefore, those already appointed will be regarded as "Members" of the Advisory Committee. Foreign representatives and others who may be hereafter appointed will be designated as "Affiliated Members." Members and Affiliated Members of the Advisory Committee shall have voice and vote alike.

The Advisory Committee will devote such time as may be necessary to the general plan of the work, and may be called together at any time by the Chairman, or by an authorized representative of the Pennsylvania Railroad.

The Testing Plant. The details of this plant are now being worked up by the Pennsylvania Railroad. It is to consist of supporting wheels upon which will be carried the drivers of the locomotives to be tested, with friction brakes on the shafts of the same, a registering dynamometer of 80,000 lbs. capacity, to which the drawbar of the locomotive will be attached, together with all necessary accessory apparatus for operating the plant and obtaining the desired data therefrom. As soon as practicable it is intended to issue a bulletin which shall completely describe and illustrate the details of the plant.

Locomotives To Be Tested. In selecting locomotives for test, an endeavor will be made to secure variety in the essential principles of design. Since the time is necessarily limited, no considerable attention will be given in attempts to analyze the action of minor details. On the contrary, the effort will be to establish the economic performance of a number of typical locomotives when operating under a wide range of conditions.

No locomotive or type of locomotives will be acceptable, the value of which has not been proven by successful service on the road.

Locomotives to be acceptable must have weight and power which will make them comparable in these respects with the modern American machine. It is proposed to test no locomotive which has less than 2,000 ft. of heating surface in its boiler, excepting that in case of locomotives having superheaters the superheating surface may be regarded as heating surface, and in the case of locomotives having Serve tubes, credit for the surface of the ribbing will be allowed.

The gage of the supporting wheels will be 4 ft. 8½ in., or the same as the standard gage of American railroads, and the gage of the locomotive offered for test must be such as to run safely thereon.

It is planned to test twelve different locomotives, and it is hoped that a portion of this number can be of foreign design and construction. The time to be allowed to each locomotive will vary from 20 to 14 working days, the longer time being allowed those which are tested early in the season when both men and equipment will be new to the work. The intervals proposed are as follows:

1904.

1. May 2 to May 23, inclusive.
2. May 24 to June 13, inclusive.
3. June 14 to July 1, inclusive.
4. July 2 to July 19, inclusive.
5. July 20 to August 5, inclusive.
6. August 6 to August 22, inclusive.
7. August 23 to September 7, inclusive.
8. September 8 to September 23, inclusive.
9. September 24 to October 10, inclusive.
10. October 11 to October 26, inclusive.
11. October 27 to November 11, inclusive.
12. November 12 to November 30, inclusive.

It is not possible at this time to present a complete list of the locomotives which will be tested, but this is now under careful consideration, and will be announced in a later bulletin.

It is considered advisable that the owner of each locomotive presented for test should furnish a man thoroughly familiar with its working to look after the lubrication, and in general, render such assistance as will insure the tests being run without interruption.

The owner should also, if found necessary, provide a man thoroughly familiar with the mechanical details of the locomotive, who can advise in regard to any repairs that may be necessary during the series of tests.

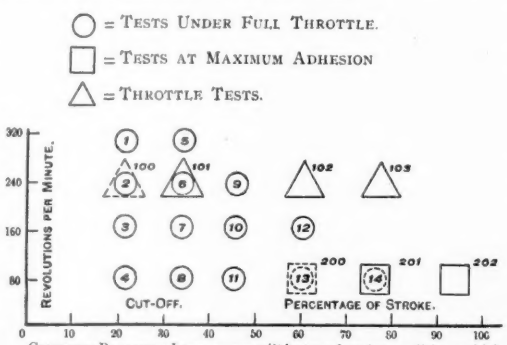
Fuel. The Pennsylvania Railroad Company will supply for all participants, two grades of coal of high quality, one an anthracite and the other a bituminous. The quality of each of these grades will remain unchanged throughout the progress of the work. This composition will be approximately as follows:

	Anthracite, per cent.	Bituminous, per cent.
Volatile matter, including water....	8	20 to 22
Fixed carbon	86	69 to 74
Ash	6	9 to 6

Firemen. The Pennsylvania Railroad will supply men whose experience on the road will have been supplemented by special training for their work upon the testing plant. Unless otherwise arranged, these men will fire all locomotives under test. Exhibitors may, however, furnish one of their own men to give necessary instructions to the regular firemen.

The Tests. It is proposed to make from 16 to 20 formal tests of each locomotive put upon the plant, these to be preceded by one or more preliminary runs for the purpose of checking the valve setting, and of proving all accessory apparatus.

Each formal test will involve a run of approximately 100 miles, and throughout its duration the speed, load, steam pressure and other conditions of running will be maintained as nearly as possible, constant. The conditions represented by the several tests upon each locomotive will be so chosen that the results will fall into sets, and when so plotted will serve to disclose the performance of the locomotive under the full range of speed and cut-off for which it can be properly worked. The conditions which have been chosen for the formal tests are set forth diagrammatically by Figs. 1 and 2.



Compound Passenger Locomotives will be tested under conditions which are comparable with those specified for simple locomotives.

Fig. 1—Simple Passenger Locomotives.

Referring especially to Fig. 1, the circles show the speed and cut-off at which it is proposed to run the tests under a fully open throttle. Tests 1 to 4 represent a set at constant cut-off under speeds varying from 80 to 320 revolutions, the cut-off for these tests to be about 20 per cent. of the stroke. All tests of this set will be well within the capacity of the locomotive. Tests 5 to 8, inclusive, represent a second set, the cut-off for which will be made such as to make the power for test 5, the highest which can be developed at a speed of 320 revolutions. A third set at longer cut-off is made up of 9, 10 and 11. In this case the cut-off of the set is to be made such that No. 9 will give the maximum power which can be developed at a speed of 240 revolutions. Similarly, test 12 is to be made at such a cut-off as to demand the full power of the boiler at a speed of 160 revolutions, and with it will be grouped test No. 13, provided the adhesion of the drivers will permit a fully open throttle under so long a cut-off.

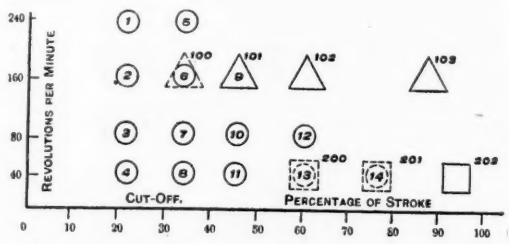
In case test 13 can be run, then another at a still longer cut-off, as, for example, test 14 at a speed of 80 revolutions, will be attempted. It will be apparent that tests under conditions thus chosen cover the entire range under which the locomotive may be operated with the throttle wide open. Thus, at any particular speed, an attempt to use the longer cut-off would result in a failure of the boiler to supply steam, or possibly, at the slowest speed, in the slippage of drivers. Similarly, at any particular cut-off, an attempt to operate at a higher speed would result in a failure of the boiler to supply steam. By combining the results the effect of either changes in speed or changes in cut-off in the performance of the locomotive can be readily shown.

To determine the performance of the locomotive under varying throttle openings the series 100, 101, 102 and 103 will be run. This series will be at a constant speed. The power for all tests and, consequently, the drawbar pull will be constant, and will be the same as that developed under a wide open throttle in test 2. For test 101 the cut-off is lengthened and the throttle closed sufficient to make the power the same as when with the shorter cut-off the throttle was wide open. Test 102 is at a still longer cut-off, for which the throttle will be still further closed, and test 103, the longest cut-off and the throttle of the least opening for the series. It is evident that the results of this series will show the relative performance of the locomotive in doing a given amount of work under a varying degree of throttling.

Tests 200, 201 and 202 are under starting conditions. The speed of all is to be the same. For test 202 the reverse lever is to be in its extreme forward position, and the throttle opening as wide as can be allowed without danger of slipping the drivers. Test 201 is with a shorter cut-off and wider opened throttle, and test 200 with a full open throttle.

It should be evident from the explanation which has been given that the diagrams Figs. 1 and 2 do not attempt to show the actual cut-offs which will be experimented upon, nor the precise number of tests which will be necessary to define the performance of a locomotive, but rather the principles which will underlie the selection of conditions, and the relation which the several tests bear each other. The limits of performance will be different for different locomotives, and one of the tests will be to establish values for these limits.

The several speeds employed for all passenger locomotives will be those set forth in Fig. 1, so that the data for the several different locomotives will be strictly comparable.



Compound Freight Locomotives will be tested under conditions which are comparable with those specified for simple locomotives.

Fig. 2—Simple Freight Locomotives.

The conditions under which freight locomotives will be tested will involve the several speeds given in Fig. 2. A comparison will show that while the range of speed for the freight locomotive is lower than that fixed for the passenger locomotive, the two sets of conditions supply ample opportunity for the inter-comparison of results which may be obtained from the two classes of locomotives.

The conditions specified for testing compound locomotives are necessarily more general than those with reference to simple locomotives, since it does not appear that any single diagram can be made which will serve to define the conditions of running with reference to compounds. For example, some of the compounds submitted for test may be of such design that a single movement of the reverse lever will change the cut-off in both the high-pressure and low-pressure cylinder (or cylinders). Others may be so arranged that the cut-off remains constant on the low-pressure cylinder until after that upon the high-pressure cylinder has been reduced to half stroke, and still others may have the control of the high-pressure cut-off quite independent of that of the low-pressure cut-off. No simple statement as to cut-off, or even as to number of expansions, will have the same force when applied to locomotives of these different types. Again, some of the locomotives may have no provision for using high-pressure steam in the low-pressure cylinder, while others may be equipped with a by-pass for use at low speed. Obviously, machines thus designed should be tested with the by-pass in use, as well as without it.

In view of these facts, it seems wise in case of compound locomotives, to reserve a specific statement of the conditions which are to prevail until the characteristics of each locomotive to be tested are known. The conditions which will then be proposed will be submitted to each exhibitor interested, for criticism, and finally for approval.

In the meantime, it can be said that compound loco-

motives will be tested under conditions which are comparable with those specified for simple locomotives. The speeds will be the same and the several tests for each speed will be under such conditions of cut-off as will disclose the performance of the locomotives under a similar range of action. The conditions to be specified for each compound locomotive will have due regard for peculiarities in its design, to the end that the power and efficiency of each machine may be demonstrated under all conditions of running which may have been contemplated in its design.

Methods To Be Followed in Running a Test. In preparation for a test, the locomotive will be started and gradually brought to the conditions of running which are to prevail throughout the test. When these conditions have been secured the preliminary running of the locomotive will be continued until the rate of firing becomes uniform and until all portions of the locomotive have become warmed to their work. When these conditions have been secured two strokes of a bell will give a preparatory signal. Thirty seconds later a single stroke of the bell will mark the beginning of the test. Upon this stroke all water levels will be observed, the ash pan cleaned and all observations taken, and thereafter all water and fuel used will be taken from a weighed supply. Throughout the test all conditions of running will be maintained as nearly constant as possible, observations being taken on the stroke of the gong at ten minute intervals. The duration of the test will vary from two to six hours, depending upon the rate of speed and load. The element of control in fixing the length of the heavy power test will be the amount of water evaporated, no test being ended until the evaporation equals 30 lbs. for each square foot of heating surface. The lighter power tests may end after from four to six hours.

A test will be ended as it began. The fire which, throughout the test will have not changed greatly in its condition, will be brought as nearly as possible to the condition it had in the beginning, the ash pan will be cleaned, the water level in the boiler will be made to agree with that of the beginning of the test, and upon signal the final observations will be taken, and the use of water and fuel from a weighed supply will cease. As soon as practicable after this the locomotive will be stopped, the front end cleaned, and the data of the test collected and made of record.

A test will be started not earlier than 8 o'clock on each day, and when the conditions are such as will permit them to be of short duration, two tests may be run on the same day.

To avoid chances for error all important observations will be taken in duplicate by the use of independent instruments and observers. For example, the feed water will be metered and afterwards weighed, the weighings constituting the real record, and the readings of the meter the check record. The speed will be indicated by a Boyer or other speed indicator, and also by a counter which will register the revolutions, the latter supplying the real record, and the former the check record. Pressures will be observed from dial gages, and registered by a Bristol recording gage, the observed pressures constituting the real record; the recorded pressures the check. A separate indicator will be used on each end of each cylinder.

The smoke discharge above the locomotive will be so arranged as to entrap all solid matter or "sparks" passing out of the top of the stack. A chemical analysis will be made of the coal employed for each test, and of the smoke-box gases.

In the case of locomotives designed with special reference to the balance of reciprocating parts, and in the case of others, the performance of which may contrast with them, an effort will be made to study the motion (rocking, nosing, etc.) of the locomotive as a whole while running at speed, in the hope that a definite relation will be found between the motion of the locomotive and its condition of balance.

In the case, also, of certain locomotives which will be selected with reference to their type of boiler, an effort will be made to secure a record of the direction and activity of the water currents circulating within several portions of the boiler when the latter is delivering steam, and especially of the cooler currents discharged from the injectors.

There will be obtained for each test, by direct observation, the following facts:

Position of reverse lever.
Position of throttle.
Revolutions per minute.
Total revolutions.
Pounds of coal fired.
Pounds of non-combustible material collected in ash pan.
Pounds of sparks passing out of the top of the stack.
Time when one or both injectors are in action.
Pounds of water weighed to injectors.
Pounds of water lost by injector overflow.
Record of calorimeter giving quality of steam in dome of boiler.
Indicator cards from each end of each cylinder, and from the valve box on one side.
Drawbar stress as shown by dynamometer.
Pressures as follows:

Of steam in boiler.
Of steam in branch pipe leading to cylinder.
Of air in the laboratory (barometric pressure).
Of air in ash pan.
Of gases in furnace.
Of gases in front-end.

Temperatures as follows:
Of the laboratory.
Of the feed water.
Of steam in branch pipe (for throttling tests only).
Of smoke-box gases.
Of water within the lower portions of the boiler at points systematically arranged.

Calculated or Observed Results. The organization will be such as will allow the work of the computing room to keep pace with the development of observed data in the laboratory. The data will be presented in such form as will show the facts in three different relations.

1. The performance of the locomotive as a whole, under which relation general comparisons will be based on work developed at the drawbar.
2. The performance of the boiler.
3. The performance of the engines.

By having a separate presentation of the engine and of the boiler performance it will be possible to trace the effect of each modification in design, whether in the boiler or engine; that is, changes in boiler performance resulting from changes in proportions or forms, will readily be traced, and changes in engine performance resulting from difference in design can be accredited to their proper cause. Moreover, it will be possible in the final analysis of results to interchange the boilers and engines of different locomotives, and to predict with certainty the general results which would have been obtained from a locomotive made up of any such combination. All of these facts will receive due attention in the preparation of the outline hereafter to be issued, which will govern the presentation of results.

Locomotive Accessories. Locomotives submitted for test must be equipped with such accessory apparatus as may be necessary for the attachments of all instruments of observation, so that there need be no delay in getting the locomotive into operation after it is received at St. Louis. Such accessory apparatus will consist chiefly of indicator plugs for cylinders and valve box, a water gage glass for locating the height of water in the boiler, reducing motions for indicators, plugged openings into the boiler front-end, pipe connections which will serve in the attachments of gages, thermometers and gas samplers, a light return crank for the attachment of a Boyer speed recorder and a registering counter, a drilled coupling pin hole in the foot plate, with a tin turned to fit, and provision for lubricating all journals when the locomotive is in motion. The exact character of each of these details will be made the subject of a later announcement.

Publication of Results. In order that the results may serve the largest purpose possible it is proposed to issue publications as follows:

1. Bulletins of Announcement. These will constitute the communications of the Pennsylvania Railroad and its Advisory Committee to the public, with reference to their plans and purposes. They will give information to those who may exhibit locomotives for test, and it is hoped that they will draw from those who are interested, such suggestions or criticisms as will assist in furthering its work.

2. Bulletins of Results. These will be issued from time to time, and will constitute formal reports of the performance of individual locomotives. It is expected that when tests upon a given locomotive have been completed, the results obtained, and such analysis of performance as may be based thereon, will be entirely set forth in a bulletin.

3. A formal publication to be issued at the conclusion of the whole work, presenting in such form as may be hereafter determined, the facts and conclusions developed by the whole study.

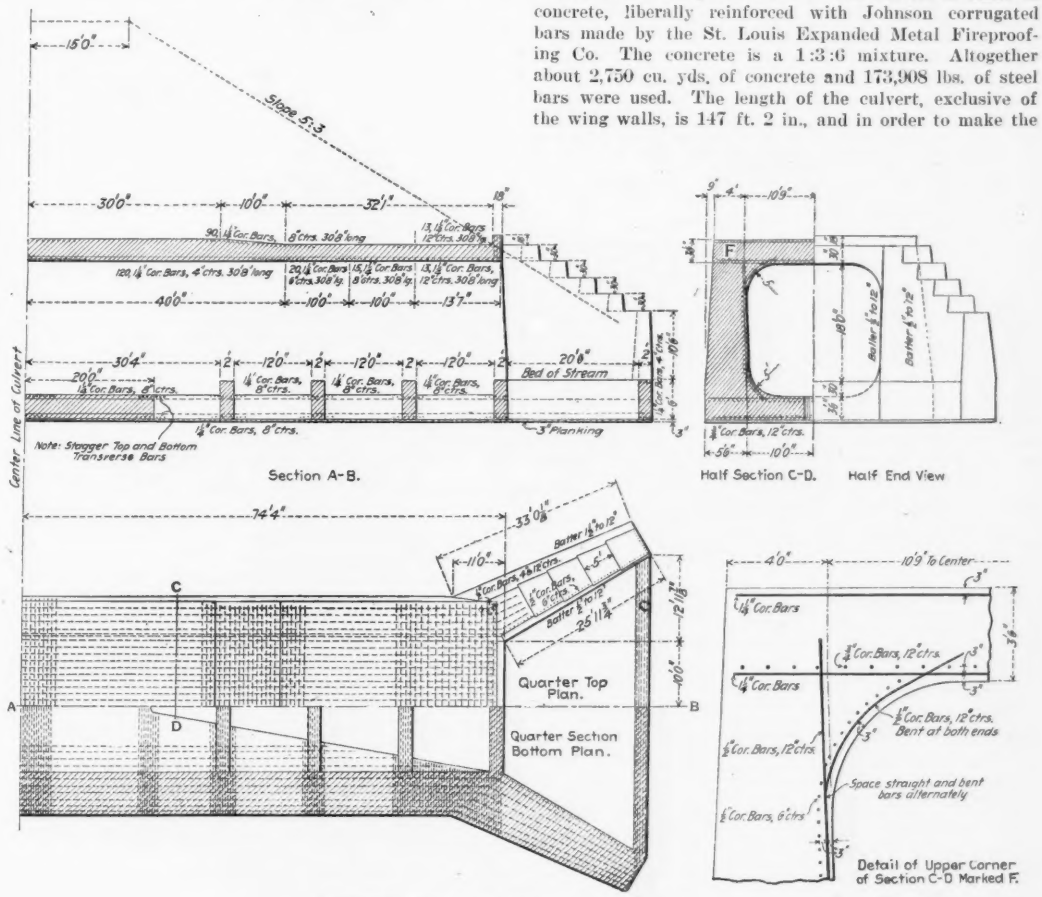
Steaming Capacity Vs. Efficiency of Front-End.

In his discussion of the locomotive front-end at the Central Railway Club, and especially in response to the question as to what change must be made in the front-end arrangement when the fuel of a locomotive is changed from soft coal to hard coal, Professor Goss said:

From the point of view which I have had in this discussion, I do not understand that the grate, or the character of fuel has any very close connection with the subject. They have a bearing on the steaming qualities of a locomotive, but I have not been discussing the question of the steaming of a locomotive. I have regarded the front-end mechanism simply as a machine for moving gases. The effort has been to so proportion this machine that the greatest volume may be drawn against a given difference of pressure, with the least possible back-pressure upon the engine. Of course, if the grate is close, there must be a greater difference of pressure to bring air through, and to maintain this greater difference of pressure, the front-end must do more work. To make the front-end do more work, it should not be necessary to change its design. The only thing that should be necessary is to reduce the diameter of the exhaust tip. When other things are right, the tip is the one element by the adjustment of which the varying conditions of fuel and of grate area are to be met. If to burn hard coal, a stronger draft is required than for soft coal, the one change which should be made in the ideal front-end when the locomotive goes from soft to hard coal is a slight reduction in the diameter of the tip. . . . When the design of the front-end is perfect, the question of steaming becomes merely a matter of the diameter of the nozzle.

Concrete-Steel Box Culvert on the Burlington.

The C., B. & Q. has just completed a 20 ft. concrete-steel box culvert over Ranne's Branch on the Creston division. The culvert is the design of Mr. C. H. Cartlidge, Bridge Engineer. The box design was selected owing to the saving in material over the usual arch culvert with its heavy abutments. The culvert is made of concrete, liberally reinforced with Johnson corrugated bars made by the St. Louis Expanded Metal Fireproofing Co. The concrete is a 1:3:6 mixture. Altogether about 2,750 cu. yds. of concrete and 173,908 lbs. of steel bars were used. The length of the culvert, exclusive of the wing walls, is 147 ft. 2 in., and in order to make the



Concrete-Steel Box Culvert—C., B. & Q.

load per sq. ft. on the foundation as nearly uniform as possible, the bottom of the culvert is cut out in the form of a V from each end as shown on the foundation plan. This V approximates the horizontal projection of the earth embankment, which is about 33 ft. high and 30 ft. wide at the center, sloping gradually to each end of the culvert. Four transverse apron walls 2 ft. wide and 6 ft. high extend across the bottom of the culvert near each end. These walls strengthen the sides of the culvert so as to prevent them from crushing in where the V is cut out. A similar apron wall extends between the outer ends of the wing walls. The arrangement of the bars is well shown by the accompanying engravings.

RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.
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EDITORIAL ANNOUNCEMENTS.

CONTRIBUTIONS.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussions of subjects pertaining to ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially either for money or in consideration of advertising patronage.*

Probably few railroad officers have omitted to watch daily the developments in Chicago during the two weeks' strike of the motormen which ended with Thanksgiving day. It cost a few lives, a great many wounds, loss of time and money to a great body of citizens, about $80,000 in wages, about a quarter of a million in fares and a great, but unknown cost to the company and the city in fighting rioters. Nevertheless, so far as this incident serves to establish and get respect for the sound principle upon which the company stood, the money and lives are well spent and the wounds are merciful, for the company's right to conduct its own business, will not again be disputed for many a year. On the other hand the men's rights, which were not in this case questioned, are nevertheless more clearly defined and more firmly established. The demands of the union in violation of principle which have been successfully resisted, are summarized as follows:

That every employee of the company shall belong to the union and that every non-union employee of the company either be compelled to join the union or be discharged.

That the employees of the company have the right to control what is known as the "routing" of cars, which includes the assignment of men and the selection of the working hours.

That no employee of the company be discharged from its service without the consent of the officers of the union, who are to be judges of the conduct of the employees of the company.

The street railway employees' union is one of the most powerful as well as one of the worst trade unions in the country. It denies the right of the non-union man to earn a living and asserts a right to share in the management of the property; and in its frequent strikes it has countenanced disorder of the most violent and cowardly sort—assassination and wholesale destruction of property. The Chicago City Railway has done a service to the whole country in demonstrating that in a law-abiding community, where the officers can be compelled to enforce the law, honesty is still the best policy. Railroad officers cannot fairly be charged with a lack of backbone in temporizing with unions in regions where people allow anarchy to prevail after a strike. A blocked railroad is about the most useless tool in the world, but the Chicago demonstration is at least this much: that, outside of barbaric conditions, it is economical to adhere to principle. The culmination of violence was reached on Tuesday, November 24, when the strikers, in addition to disabling the railroad, fought viciously, and the police used their revolvers, firing, however, over the heads of the mob. On that same night the police were ordered to end the orgie on Wednesday and shoot to kill. In sequence the strike ended on Wednesday morning at 9 o'clock. Was there ever a plainer lesson?

The Second Annual Government Accident Bulletin.

The Government record of railroad accidents in the United States in the year ending with last June was published in the *Railroad Gazette* of November 20, page 828. Comment was scarcely necessary, as the facts themselves are sufficiently impressive; but as their magnitude and the familiarity of everybody with the subject are likely to deaden our powers of apprehension, it may be well to epitomize that portion of the record which can be shown in figures. The *Railroad Gazette* train accident record, which formerly was made as complete as possible, now shows only the more prominent cases; but it continues to summarize each month a class not touched by the Government—the electric-car accidents—and the total of these monthly statements is appended to the following Government figures:

Railroad Accidents—Years Ending June 30.

	1903.		1902.	
Number of collisions	6,167	...	5,042	...
Damage caused by collisions to cars, engines and roadway	$5,615,746	...	$4,285,683	...
Number of derailm'ts	4,476	...	3,633	...
Damage	$3,981,231	...	$3,359,728	...
T'l, col. and derailm't	$9,596,977	...	$7,645,406	...
	Train accidents.	Other causes.	Train accidents.	Other causes.
Passengers killed	164	157	167	136
Passengers injured	4,424	2,549	3,586	2,503
Employees killed	895	2,338	697	1,819
Employees injured	6,440	32,564	5,046	28,665
Other persons	Not reported.		Not reported.	
Collisions & derailm'ts of electric cars	214	...	235	...
Persons killed in same	83	...	64	...
Persons injured in same	1,095	...	892	...

The record of persons killed and injured does not differ from what has been published for years past, and the totals call for no remark. The number of casualties to railroad employees is very large, but this has been explained in former Government bulletins, so far as it is explainable; (1) the number of men employed is larger and (2) the percentage of inexperienced and unskilful men is larger; (3) danger increases with the number of trains, on a given railroad, even if there be no falling off in skill and vigilance, and (4) the increase of traffic which has increased the number of men employed has also led the men to work too long hours without rest; and (5) the commission has succeeded in getting more complete reports; some roads appear to have neglected or defied the law, the first few months, sending incomplete reports.

But the record of the losses caused by collisions and derailments is not so commonplace. Not until the Government bulletins came out did we know how much these losses amounted to. Even now, the ten millions, almost, which is shown in the record, represents probably not more than a half of the actual cost of these accidents, for to get the true total we should have to add the large sums paid for deaths and personal injuries and for freight destroyed and damaged. Moreover, damages due to boiler explosions (when no derailment occurs) are not included in the record.

It is true that ten millions, or even 20, is a small sum to deduct from the enormous receipts of the railroads of the United States. Twenty millions, which may fairly be taken as the gross loss, is probably about one per cent. of the gross earnings of the whole of the railroads of the country, as will be seen by reference to the first item in the following table. (Figures for 1903 are not yet available, but they may be safely assumed to be appreciably larger than those for 1902.)

Railroads of the United States, Year to June 30, 1902.

Gross earnings	$1,726,380,267
Operating expenses	1,116,248,747
Dividends paid	185,421,239
Taxes paid	54,465,437
Number of revenue train miles	936,148,675
Damage, by collisions and derailments, to cars, engines and roadway	$7,645,406

Twenty millions is equal, however, to about 33 per cent. of the sum paid out as taxes (1903); and to about 10 per cent. of the dividends. Per train mile the train accident cost for 1902 is about 1⅔ cents ($7,645,406 plus $7,645,406, estimated personal damages and losses of merchandise, equal to $15,290,812; divided by 936,148,675 miles).

But a percentage is not a genuine criterion. One may consider that his accidents cost him one-third as much as his contribution to the support of Government, and groan over the burden; or he may reflect on the smallness of the accident losses, as compared with a billion and three-quarters, and thus minimize the expenditure; but in either case he is only looking at the matter from the accountant's standpoint. The vital question is not touched upon in either view; the real problem has to do, not with the Commission's tables of figures, but with the 12 pages of causes of accidents which have appeared in the four bulletins of the year. These pages appeal, not to the accountant, but to the superintendent. These four bulletins have shown the causes of the 134 accidents of the year which were prominent by reason of their magnitude or peculiar causes. Three of these caused damages of $50,000 or over, each; and 15 cost $25,000 or over each. It is not the purpose of this article to discuss causes, for that has been done month by month as the accidents occurred; but in order to relieve the dry figures of some of their dryness, we append the names and dates of a few of the more notable cases of the twelve-month. If any railroad officer is inclined to deal with this subject wholly on the basis of percentages of earnings or of gross expenses, the recollections aroused by a perusal of these names should be sufficient to stir the blood, for nothing is plainer, in the narratives of the negligence that caused these accidents, than its likeness to negligence which occurs everywhere, and which therefore demands the watchful care of every superintendent.

Most Notable Train Accidents of a Year.

1902	July, Trebeins, Ohio	.....
	July, Pack Saddle, Pa	.....
	September, Berry, Ala	22 passengers killed
	December, Byron, Cal	22 passengers killed
1903	January, Chiwaukum, Wash	12 employees killed
	January, Westfield, N. J	21 passengers killed
	January, Esmond, Ariz	12 persons killed
	February, Berea, Ohio	.....
	March, Olean, N. Y	.....
	April, Red House, N. Y	.....
	June, Raymond, Iowa	.....

The Manhattan Bridge Designs.

That Mr. Richard S. Buck's criticism of the Manhattan Bridge design appears on another page at the same time that the designs are published, is merely a coincidence. It is fair to Mr. Buck to say that his article was written without the opportunity of examining the detailed drawings. No engineer, or other thoughtful person, likes to be put in the position of criticising or objecting to a trial of a bold or novel design in construction. The imagination, courage, and splendid achievements of American bridge engineers, which have put the profession in this country so far in the lead, would never have been possible of demonstration without the confidence and support of those who enabled them to prove that what is untried may nevertheless be good.

The report of the Committee of Experts is sufficient ground for endorsing the practicability of the eye-bar cable design, but not necessarily the comparative desirability of it. The men who served on that committee are well qualified to give an opinion on the feasibility of making and using eye-bars of the size and material required. Nickel steel is not the unreliable or expensive material which we might be led to believe it to be from the objections raised against it in some quarters. It is not a much newer engineering material than Bessemer steel, having been first exploited in 1889, although its properties were first observed in 1859. Both in this country and in Europe, while its manufacture on a commercial basis has been confined to a few companies, material progress has been made, and it may be fairly said that nickel steel has passed from the experimental stage to the very practical and useful one. Its value as a material of construction in locomotive parts, heavy gun and miscellaneous forgings and armor plate has been satisfactorily demonstrated in actual practice; and for rails its worth is pre-eminent. Even at double cost, it is being used in increasing quantities on sharp curves in dangerous places. It can be made in almost any quantity with the same certainty and predetermined composition as simple steels. Of course the introduction of nickel, which is expensive, increases the cost, but not greatly in excess of the proportional increase in strength, and in some confined places the reduction in the necessary section made possible by the increased strength is worth far more than the additional cost of the stronger material. So far as forming the heads on the eye-bar is concerned, it is no more difficult to work nickel steel than open-hearth simple steel under the hammer or in the forging press.

As yet no eye-bars of the size proposed for this bridge, made either of nickel steel or simple steel, have ever been used, and naturally there is uncer-

tainty as to the cost of producing such parts, and as to their uniformity and strength when produced. But it is the oft-repeated history of advancements in engineering, when the world at large doubts and says a thing can't be done, that someone wiser than the rest comes along and does it. The resourcefulness and enterprise of the American steel-makers inspire a feeling of confidence that if 18-in. eye-bars of nickel steel are wanted, they will be forthcoming. The desirability of building the bridge of eye-bar cables is a different proposition from the possibility of doing it.

Because straight wire cables have proved to be strong, enduring, and economical in supporting long span bridges, it by no means follows that they are the strongest, the most enduring, and the most economical form. It may be that nickel steel eye-bars will give better results, but Mr. Buck is on safe ground when he asks that this be proved before tried, and when he demonstrates that the factor of safety in the substitute design is less than that assumed for his own design, he shows that the comparison is unfair.

This present discussion, and the sometimes acrimonious discussion that has preceded it, ought to be unnecessary. The questions involved of strength, first cost, time in construction, capacity, durability, and economy of maintenance, are, in the present state of the engineering art, capable of solution without a controversy, but this does not mean without scientific investigation and full discussion. The substitute design should be compared with the original design, and, as to cost and time of construction, there seems to be but one way in which such a comparison can be made; the original design should be completed and specifications made for it, and bids for both should be obtained. It is idle to make estimates based on the fact that the wire for the Williamsburg Bridge cost about 15 cents a pound, and that the nickel steel for the Blackwell's Island Bridge was estimated to cost about 6 cents a pound, and that, nevertheless, the bid was 8.3 cents a pound. The present cost of wire has not been made known, although it is estimated to be about 12 cents a pound, and this estimate is not based on a greatly decreased cost of material, but rather upon the lessened cost of erection due to a better knowledge of the art. The expense of completing the original design and obtaining bids is a material one; but, in the first place, it seems to be the only way of finally determining the comparative economy of the two designs, and, in the second place, it will incidentally act as a needed spur to competitive bidding on the eye-bar design.

There should not entirely be left out of mind the consideration that the eye-bar cable with its stiffening truss is fundamentally more artistic than any wire cable suspension can be made. There is an apparent strength where, to the layman's eye, strength is most needed. The charm of Gothic architecture, which required a thousand years for full development, is its evident strength and solidity developed in beautiful curves. The eye-bar and the cable bridges have the same graceful modified catenary curve, but the wire cable marks the line indistinctly, and to an untrained engineering eye, it appears to be weak. Its mighty strength is hidden. A glance at the drawings of the eye-bar design shows how completely this artistic objection is overcome in this new design. The rocking towers are graceful and their strength is obvious. These qualities, although minor ones, nevertheless deserve consideration, for the monumental qualities of the great public works in what promises to be the greatest city of the world have a value not to be ignored by engineers.

A correspondent's inquiry, answered in another column, recalls some interesting incidents in the early history of the Mauch Chunk Railroad, which, at the time of its building, was the longest railroad in the United States. The highway from the mines to the river was a turnpike laid out in 1818 and finished in 1819. A description of the project, published in 1840, says that it was "believed to be the first road ever laid out by an instrument on the principle of dividing the whole descent into the whole distance as regularly as the ground would permit and have no undulation." The topography and natural conditions of the country which the road was to traverse appear to have presented a discouraging prospect to its promoters. One of a committee of two sent over the proposed route to investigate conditions reported that the making of a good road to the mines was utterly impossible, "for, to give you an idea of the country over which the road is to pass, I need only tell you that I considered it an easement when the wheel of my carriage struck a stump instead of a stone." In 1826 more than 31,000 tons of coal were sent down from the mines and with this amount of business it was difficult to keep the turnpike in good working condition without coating it with stone. This decided the building of a railroad. The method of operating the road is briefly described in the answer to the correspondent's inquiry.

Union Pacific.

The striking feature about the previous annual report, issued for the year ending June 30, 1902, was the great increase in gross earnings accompanied by a relatively slight increase in operating expenses, so that the excess of receipts over operating expenses and taxes was nearly $3,000,000 greater than in 1901. In the report at hand, although gross earnings show an increase of $3,574,909, since 1902, operating expenses increased $3,150,418, leaving a balance of receipts over operating expenses greater than reported last year, but not nearly as great in proportion to the earnings. To put it in another way, during the year under review gross earnings increased 7.53 per cent., but operating expenses increased 13.02 per cent., so that the ultimate increase of receipts over operating expenses, compared with the year previous, was only 1⅘ per cent. Cost of conducting transportation, which increased well over $2,000,000, was the chief cause of the poorer showing this year, although the charge for maintenance of equipment increased nearly $1,457,000. The charge for maintenance of way and structures was $654,000 less than last year. The chief causes of the increased expenses are briefly stated as being the increase in wages and additional cost which generally results from an unsettled condition of labor; the greater cost of material and supplies used in the operation of the road, and the increase in expenses which attends a congestion of traffic such as existed in the fall of 1902. The decrease in the current charge for maintenance of way and structures is attributed chiefly to the good effect of the large renewals and permanent work done previously; repairs of bridges, culverts and viaducts, decreasing $117,548, for example; partly as the result of the increase in the number of permanent bridges, while renewal of rail, frogs, switches, and fastenings, cost $666,286 less than in 1902. The important increase in the charge for maintenance of equipment, which cost nearly 32 per cent. more than in 1902, was occasioned chiefly by repairs and renewals of locomotives, and the average sum spent per locomotive on repairs and renewals, including the difference between the original cost, the inventory value of old locomotives scrapped, and the price obtained for the same, was $3,590 as against $2,733 last year. Included in the cost of conducting transportation is an increase of $728,835 in the cost of fuel, resulting in part to a 10 per cent. increase in the number of miles run in revenue service, and otherwise from an increase in the cost of coal. Locomotive service other than fuel and train service increased slightly more than this.

Total gross earnings for the year ending June 30, including the water lines, which earned nearly $859,000, were $51,075,189 as against $47,500,279 last year. Total operating expenses were $27,339,884, as against $24,189,466, and net earnings were $23,735,305 as against $23,310,814. In addition to the increased sources of expense, noted above, which were felt by almost all the railroads in the country during the past year, the Union Pacific suffered heavily from the floods last June. In all, about 274 miles of main track were submerged, roadbed and bridges washed out or seriously damaged, and much ballast washed away, besides damage done to tracks, yards, and buildings at Kansas City, Topeka, and other points. Operations on the Kansas division in the valleys of the Kansas and Smoky Hill rivers were partly suspended for nearly three weeks and the estimate for the replacement of the property damaged amounts to about $500,000.

The following table is of interest as showing the gains which have been made by the company since the reorganization. The Union Pacific Railroad Company, succeeding the old Union Pacific Railway, did not commence operations until February, 1898, and the Oregon Short Line and the Oregon Railroad & Navigation Company were not operated by the Union Pacific until 1899, but for purposes of comparison the receipts and expenses for 1898 and 1899 are restated in the report to include the working of the properties subsequently taken over.

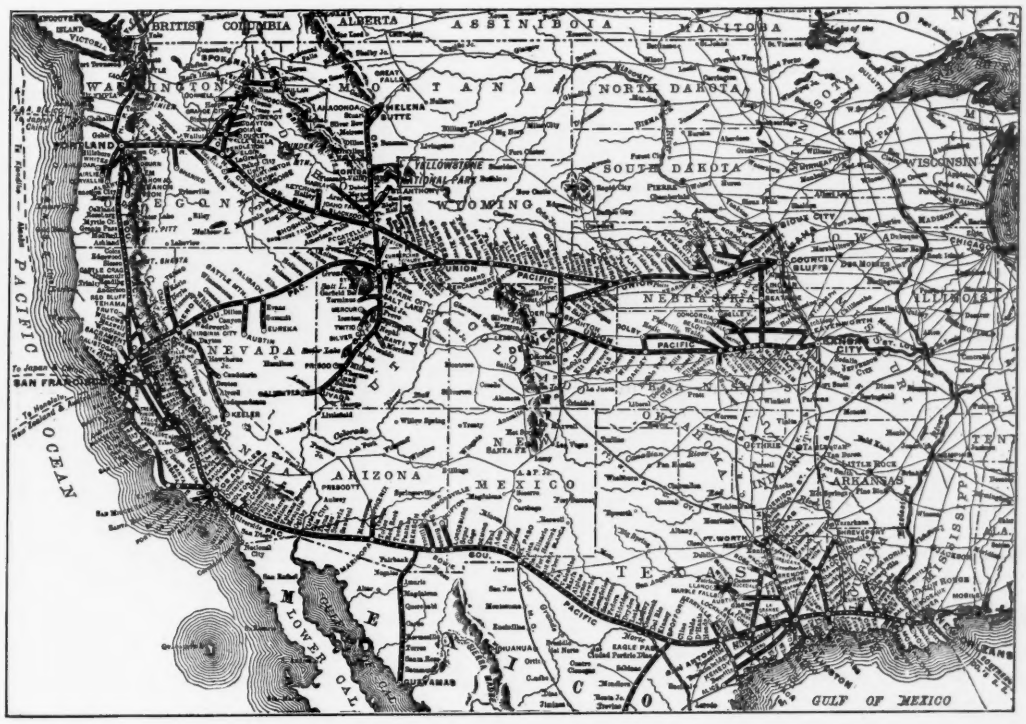
	Miles of road.	Gross receipts.	Oper. exp. and taxes.	Net earnings.
1898.....	5,337	$32,631,769	$19,580,291	$13,051,478
1899.....	5,399	34,394,729	19,068,187	15,326,542
1900.....	5,428	39,147,697	21,427,546	17,720,151
1901.....	5,543	43,538,181	24,587,145	18,951,036
1902.....	5,711	47,500,279	25,559,226	21,941,053
1903.....	5,762	51,075,189	28,747,216	22,327,973

A summary of the changes shows that the miles of road worked in 1903 have increased 425, or 7.96 per cent. since 1898. Gross earnings have increased $18,443,420, or 56.52 per cent.; operating expenses and taxes have increased $9,166,925, or 46.82 per cent., and net earnings have increased $9,276,495, or 71.08 per cent.

The total net income available for fixed charges and dividends after receipt of interest from stocks of other companies owned and rentals was $26,975,816, as against $26,521,655 last year, and from this net income $11,675,704 was deducted for total fixed charges, as against $11,989,479 last year, the decrease being occasioned by a reduction of $1,408,251 in interest on loans and open accounts which more than compensated for an increase of $1,094,880 in interest on funded debt outstanding in the hands of the public, owing to the sale of Oregon Short Line 4 per cent. bonds, as described in the report for 1902. The ultimate surplus over fixed and contingent charges was $15,276,642, as against $14,503,249 last year, and out of this surplus dividends aggregating $8,333,168 were paid, amounting to a total of 4 per cent. on the preferred and 4 per cent. on the common stock of the Union Pacific Railroad Company, and 4 per cent. on the preferred stock of the Oregon Railroad & Navigation Company held by the public, the latter being a very insignificant amount. From the year's income, two millions were appropriated for betterments, equipment, and repairs to flood damages, $500,000 of the total being set aside as a resource fund for future betterments and additions.

The changes in capital stock show an increase of $4,712,722, of which practically the entirety was exchanged for an equal amount of Union Pacific Railroad first lien convertible 4 per cent. bonds. The net increase in funded debt was $31,174,000. Oregon Short Line 4 per cent. and participating 25 year gold bonds were issued to the amount of $36,000,000, covering the floating debt incurred by that company in the purchase of securities, and $128,000 O. R. & N. consolidated mortgage 4's were also issued in exchange for 6 per cent. bonds of the same face value purchased and cancelled. The reductions against this gross increase were occasioned by the conversion of Union Pacific first lien convertible 4's into stock, as referred to above, and by the purchase of other bonds.

The net proceeds from the sale of the lands belonging to the Union Pacific are set apart as a cash improvement



Union Pacific, Showing also the Southern Pacific.

and equipment fund to provide for any expenditures for betterments, equipment or other properties not otherwise charged, and for the year under review $915,587 of net proceeds were thus applied. The total amount received, including cash and principal of deferred payments, was $1,491,682, and the average price received per acre was $1.77. On June 30, 4,809,651 acres remained unsold. The estimated value of land and town lots remaining unsold was $3,817,381, and there were $6,330,772 land contracts outstanding.

The net charge against capital assets for extensions, betterments, equipment, etc., including $1,444,517 premiums on property acquired, amounted to $4,540,293. The betterment work charged to income, including improvement and equipment fund and land account, was $3,434,547. Important work done in the year includes a reduction of nearly three miles in the length of timber bridges, the expenditure of nearly $600,000 on the Omaha shops, which are now practically completed, including extensive grade changes, the establishment of wood preserving plants and a large amount of track and grade betterment. The changes in equipment during the year include 20 locomotives acquired, charged to earnings, and 32 charged to capital, against 17 destroyed or condemned; and 645 freight cars added against 418 destroyed. The locomotives added during the year average 93½ tons total weight of engines without tender and 79½ tons upon drivers. The freight cars added during the year were of 50 tons capacity. The number of passenger miles per mile of road increased from 70,126 to 77,984. Ton miles per mile of road increased from 751,051 to 777,818, and gross earnings per mile increased from $7,977 to $8,510. The revenue train load fell off considerably, the figure for the year being 403 tons as against 418 tons in 1902. Other statistics of operation follow:

	1903.	1902.
Average mileage worked	5,762	5,711
Freight earnings	$36,261,679	$33,982,782
Passenger earnings	12,776,283	11,571,201
Percentage exp. to earnings	53.53	50.92
Water lines, earnings	858,940	860,650
Gross earnings	51,075,189	47,500,279
Operating expenses	27,339,884	24,189,466
Net earnings	23,735,305	23,310,814
Maintenance of way	5,293,475	5,947,906
Maintenance of equipment	6,025,640	4,568,699
Conducting transportation	13,827,532	11,686,928
Surplus applic. to dividends	15,276,642	14,503,249
Balance carried forward	6,943,474	6,315,961

NEW PUBLICATIONS.

Poor's Manual of Railroads. 36th annual number. 1,900 pages. 24 colored plate state and group maps and 50 maps of leading railroads, etc. Royal octavo, cloth. Poor's Railroad Manual Co., publishers, 68 William street, New York. Price $10.00, charges paid.

Poor's Manual is so familiar and so indispensable as a careful and full record of railroad and corporation securities and operations that it needs no word of introduction. A summary of some of the more important statistical tables appearing in the present issue was printed in the *Railroad Gazette*, Nov. 20, p. 828. The only criticism to be offered of this excellent publication is that its current value is somewhat lessened by its very tardy appearance, since although it appears at the close of 1903, most of the railroad returns and all of the tabulated statistics are for the 1902 year. The current issue contains 34 more pages of matter relative to steam railroads than heretofore, and 257 pages are devoted to electric railroads, as against 239 in 1902. Industrials are given 145 pages, as against 113.

TRADE CATALOGUES.

The Union Switch & Signal Company, Swissvale, Pa., has issued *Section 4* of its Catalogue of Interlocking and Signal devices. Sections 1, 2, 3 and 5 have been published at intervals during the past 18 months, as heretofore announced. Section 4, now issued, deals with "mechanical interlocking signals," and shows 56 outline drawings of semaphores. Not all of these are numbered and minutely described; the variety is introduced so as to show every necessary or desirable combination of one-arm, two-arm, and three-arm signals; single post, bracket post, double bracket post, bridge, etc. Of the more common patterns, detailed drawings are given, with the parts numbered. Both wood and iron posts are shown, and signals are shown connected both by pipe and by wire. The great variety of designs demanded nowadays by the railroads is suggested by Plate 466, showing dwarf signal spectacles, of which there are 19 patterns. Seven different semaphore lamps are shown and six styles of burners.

Ingersoll-Sergeant Drill Co., New York, describes a number of labor saving tools operated by compressed air in a small catalogue recently issued. These include the Haeseler axial-valve hammer made in five sizes for chipping and miscellaneous work and three sizes for riveting; a pneumatic "holder-on" or dolly bar; portable rivet forge; piston air drill; rotary breast drill; and a simple and compact form of hose coupling. All of these tools represent the latest development in pneumatic appliances and each is illustrated and described with full directions for ordering either the whole tool or the individual parts for repairs or renewals.

Hyatt Roller Bearing Co., Harrison, N. J., in Bulletin No. 20 describes the construction of the Hyatt flexible roller bearing and illustrates its application to machines working under heavy loads at slow speeds, such as traveling cranes, shop trucks, core oven cars, tumbling barrels, pulverizing machines and many others. Tables are given by which bearings may be designed for various loads and a fully illustrated description of the method of application. The distinctive feature of the Hyatt bearing is the roller which is made from a strip of steel wound into a coil of uniform diameter. This construction gives the bearing its flexibility and consequent uniform distribution of load on the rollers resulting in high efficiency and absence of wear.

Duff Mfg. Co., Pittsburg, Pa., has issued Catalogue E, dated January, 1904, in which are described and illustrated the various types of Barrett jacks which the company makes. Each form of jack is briefly described and a detailed list of parts and prices for each is given. The Barrett automatic lever jack is adapted for a wide variety of uses and special designs are made for track work, oil wells and pipe forcing and motor armature lifting. Other special jacks are also described in this catalogue among which are automatic lowering, car and car box, differential screw, automobile jacks and traversing jack bases.

Kaltenbach & Griess, Cleveland, Ohio, make a pile driver for railroads which is described and illustrated at work in Bulletin No. 6, just published. It is known as a standard No. 2 machine and fulfills all the requirements of railroad work, rapid driving, long reach of leads, simple and compact mechanism, self-contained when made ready for transfer, and having a strong self-propelling gear with ample boiler and engine capacity. This firm also builds locomotive coaling plants, wrecking cranes, gantry cranes and other like machines.

The ninth annual catalogue of the *Light Inspection Car Company*, Hagerstown, Ind., contains illustrated descriptions of the different styles of man-propelled light inspection cars made by this company. There is also shown for the first time in this catalogue the standard-gage gasoline motor car, several of which the company has had in service for over two years, and which it is now ready to put on the market. Two sizes of these cars are built, the smaller size being shown in the catalogue.

The North-Western Limited is the title of a pamphlet got out by the Passenger Department of the Chicago & North Western. The equipment and conveniences of this handsome train are described in detail and are illustrated by half-tone engravings; also diagrams of the cars are printed in colors. Bird's-eye views of St. Paul and Minneapolis and views of points of interest along the route are included. The pamphlet is most attractive in design and printing.

The B. F. Sturtevant Co., Jamaica Plain, Mass., announces the second edition of its condensed general catalogue No. 115. A few pages in this revised edition have been devoted to factory and industrial railroad equipments, a new department which has been established since the company equipped its new plant at Hyde Park, Mass.

The December number of *Graphite*, published by the Joseph Dixon Crucible Co., Jersey City, N. J., contains the usual series of bright anecdotes connected, more or less directly, with graphite and its uses. A full-page photograph is reproduced of the Knickerbocker Hotel, now building at the corner of Broadway and 42nd street, New York, the structural steel in which is protected with Dixon's silica-graphite paint.

Cranes is the title of a small supplementary catalogue of the Northern Engineering Works in which are illustrated a number of typical installations in pumping stations, electric railroad power houses, large industrial plants and lighting stations. Electric traveling cranes and hand power chain and drum hoist cranes are shown installed in a number of plants where they are in operation.

Arthur Koppel, 66 Broad street, New York, issues a supplement to his catalogue, No. 77, of track and transportation materials for shops and the industrial works. The diagrams and dimensions of his standard switches and turn-tables for portable track are among the interesting and valuable features.

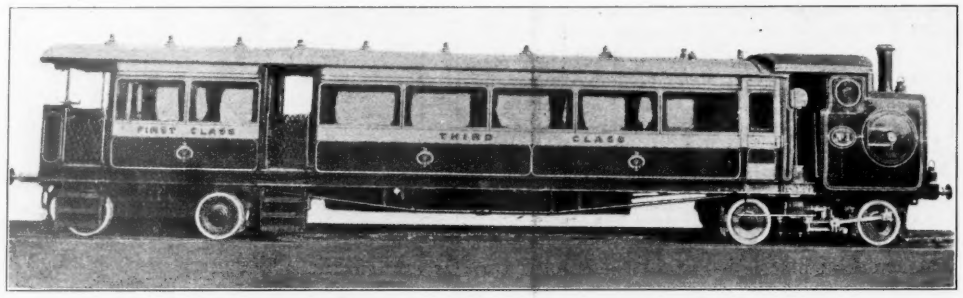
Steam Motor Car for the Taff Vale Railway.

A number of English railroads have recently been experimenting with steam motor cars in an attempt to operate branch and suburban lines with greater economy and in some cases to compete with electric lines paralleling the railroad. Cars built for the Great Western and London & South-Western have already been described in the *Railroad Gazette* (Nov. 6, 1903, p. 802, and June 19, 1903, p. 425). The latest experimental car, built by the Taff Vale Railway, is shown in the accompanying engraving. It differs in several respects from the two cars already described, chiefly in the arrangement of compartments for first and third class passengers and in some of its mechanical details.

The Taff Vale car has accommodations for 12 first class and 40 third class passengers as well as for baggage and parcels. The first class compartment, which is at the opposite end from the boiler, has longitudinal seats upholstered with figured velvet plush, and the roof is of linerusta walton. The third class compartment is furnished with transverse seats arranged in pairs, back to back, and divided by a central aisle. The seats have teak frames and oak slats and the roof is of bird's-eye maple veneer. Basket racks for light packages are also provided. Both compartments are heated with steam from the engine.

There are two entrances to the car, one from the end platform, opening into the first class compartment, and one between the first class and third class compartments, from which entrance may be had to both. Both entrances are fitted with folding gates and extension steps which reach to the ground level and which may be folded up under the car body when not in use, by a lever operated from the end platform. The underframe of the car is of steel. One end is carried on the engine truck and the other on a standard four-wheel passenger truck fitted with Kitson wood-cushioned wheels.

Steam is generated in a multi-tubular boiler with steel plates and copper fire-box, and 312 tubes, 1¾ in. in diameter. The cylinders are 9 in. diameter x 14 in. stroke, and are fixed between the wheels, outside of the truck frame. They are connected to the end pair of wheels. A Stevenson link motion valve gear is used, operated with screw reversing gear from the cab and with the eccentrics mounted on the driving axle between the frames. The rear pair of wheels on the engine truck are not coupled. Steam and hand brakes are provided and communication between the cab and platform at the other end is maintained with a system of electric-bell signals.



Steam Motor Car for the Taff Vale Railway.

Some of the principal dimensions of the engine, boiler and car, follow: Length of car body, 45 ft.; width of body, outside, 8 ft. 6 in.; length of first class compartment, inside, 8 ft. 11 in.; length of third class compartment, inside, 26 ft. 1½ in.; width of cross-gangway, 2 ft. 8 in.; height from floor to roof, 7 ft. 2½ in.; length of car over buffers, 58 ft. 9 in.; total wheel base, 49 ft. 3½ in.; car truck wheel base, 8 ft.; diameter of wheels, 2 ft. 10 in.; engine truck wheel base, 8 ft. 6 in.; grate area of boiler, 8 sq. ft.; heating surface, fire-box, 39 sq. ft.; heating surface, tubes, 299.5 sq. ft.; total heating surface, 338.5 sq. ft.; working steam pressure, 160 lbs.; tractive power at 80 per cent. boiler pressure, 4,263.29 lbs.; total weight of car and engine, 74,160 lbs.

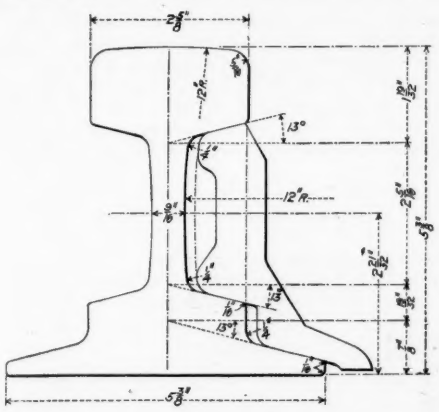
We are indebted to *Transport*, London, for the illustration and description.

The Heinle Compound Rail.

One of the greatest difficulties in rolling rails of the Am. Soc. C. E. standard section is in controlling the cooling of the head and flange so as to prevent undue internal stresses. With this standard section there is a large body of metal in the head, which retains its heat much longer than the thin body of metal in the flange. When making the final passes through the rolls the head of the rail must be finished at a temperature higher than is desirable for obtaining the proper internal structure since the flange is at such a low temperature that further rolling would produce serious internal stresses and consequent warping and buckling of the rail. Numerous methods have been devised to equalize the heat in the different portions of the rail, all of them more or less unsuccessful. One of the commonest is to keep the flange hot by contact with the head of the adjoining rail while the rails are on the cooling bed. This partially prevents warping and reduces the internal stresses which occur in cooling.

The accompanying engraving shows a rail section which is as nearly symmetrical about the horizontal axis through the web as it is possible to make it and at the same time

preserve the standard dimensions of rail head and width of flange. The same weight of rail is obtained with a reduction in height, as shown in the engraving. A compound rail weighing 100 lbs. per yard can be made in the same rolls now used to make 90-lb. rails and it is 5⅜ in. high, as compared with a standard 100-lb. rail, 5¾ in. high. The only modification necessary is a slight alteration of the passes in the rolls which form the flange. The increased metal in the base of the rail gives it greater

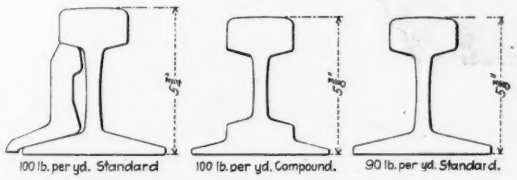


Section of Heinle Compound T-Rail and Splice.

transverse strength to resist the vertical wave movement in the rails between tie supports.

The greatest advantage, however, in this section is in the ease and facility with which rails may be rolled. The rail becomes practically symmetrical about both the horizontal and vertical axes and an equal amount of work is put into the metal in reducing it from the bloom to the finished rail. The operation becomes no more difficult than rolling I-beams, or other symmetrical sections, since the temperature effects and the mechanical working are the same in both the head and flange.

In rolling the standard rail section there is always



Standard Rail Sections and Compound Section.

difficulty from curvature and distortion. This arises both from the difference in temperature and elongation and in the amount of work put into the head and flange. The flange cools rapidly and the difference in temperature which affects the relative expansion and contraction of the head and flange gives the rail a decided camber which must be eliminated by straightening or gagging with a consequent stress in the fibers in the base of the rail. By equalizing the amount of work put into the head and flange and giving the rail a symmetrical section, so that equal bodies of metal are cooled at the same rate, the internal stress is greatly reduced and a more homogeneous rail is produced. The square of the standard rail section approaches approximately the square of the bloom from which the rail is rolled and less reduction of metal is required to form the rail, leaving the metal more nearly in the molecular state in which it was cast in the ingot. The compound section with the reduced height for the same weight per yard requires a greater reduction of metal to form it which gives a dense homogeneous structure to both the head and flange. This section of rail has been patented by Mr. A. W. Heinle, Crafton, Pa., who is also the inventor of the Heinle Continuous-Tread Rail Joint, described in the *Railroad Gazette*, November 13.

Lassiter Straight or Taper Bolt-Turning Machine.

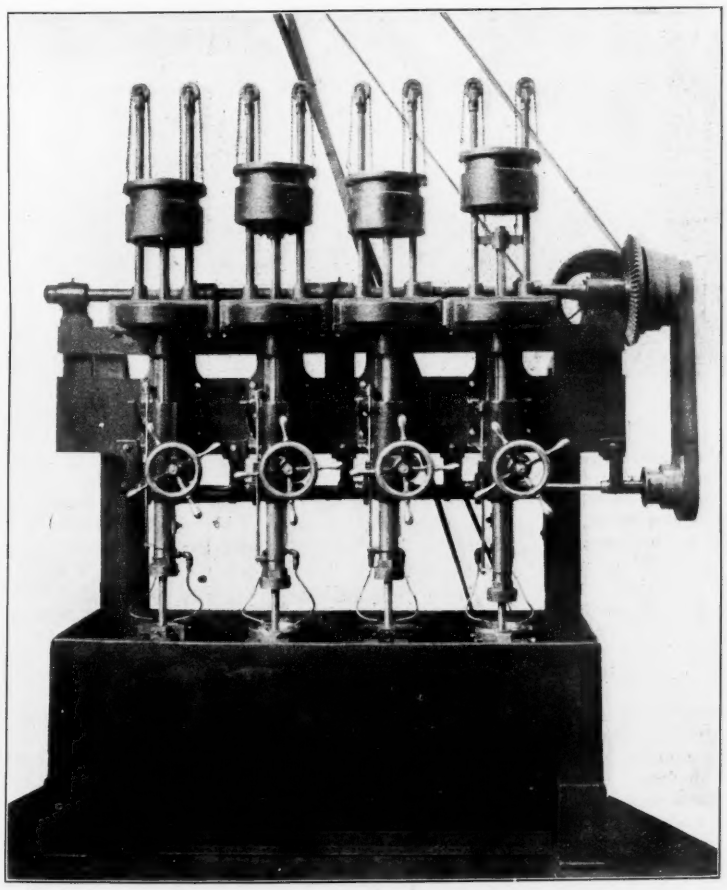
The accompanying illustration shows a machine which has been devised for greatly reducing the time consumed and the cost of turning taper or straight bolts such as are used in locomotive building, in railroad shops, and for general manufacturing purposes. It has been designed and patented by C. K. Lassiter, Mechanical Expert at the Schenectady Works of the American Locomotive Co., and has been adopted by that company for the making of all the straight and taper bolts which are used in their different works.

The machine may be driven from an overhead countershaft or by electric motor and is wholly self-contained. The spindles are counterbalanced to facilitate easy and rapid movement by hand; they can be driven independently of each other or in multiple. Quick return or advance motion can be given to each spindle when the power feed is disengaged by a hand wheel, rack and pinion. Each spindle has a friction safety stop mechanism, so arranged as to stop the action of the feed gear in case any excessive resistance should take place during the cutting operation, and the liability of breakage is thus reduced to the minimum.

A simple and positive automatic stop for each spindle can be quickly adjusted so as to stop the spindles in any desired position within the capacity of the machine. The power feed can also be disengaged at any point by hand regardless of the adjustment of the automatic device.

The end of each spindle is threaded to receive a bolt driving chuck. This chuck is counterbored to receive interchangeable bushings of hardened steel which are properly constructed to receive and drive the forged head of the bolt whatever its size or shape. The only preliminary work required is to roughly point or round the end, that the cutters may begin to cut on a clean even surface.

The machines are at present made in two sizes for bolts from ¾ in. to 1⅜ in. diameter, the smaller size being suitable for lengths up to 12 in., and the larger size taking bolts up to 18 in.; the number of cutter heads required depending on the range of sizes and lengths and whether straight or taper bolts are to be turned. The four cutter heads shown in place are suspended vertically in four holders and clamped rigidly to them. These holders are so constructed as to permit of a slight oscillating motion which prevents undue lateral stresses on the spindles, producing an absolutely true, straight or taper bolt regardless of irregularities in the forgings. The cutter heads, which contain the cutter blades, guides, wedge blocks and keys for adjusting the cutter blades and guides in vertical or radial positions, are simple and substantial. In order to obtain correct adjustment a plug gage of the desired dimensions is held in the central portion of the head until all adjustments have been made.



Lassiter Taper Bolt Turning Machine.

In the illustration two roughing and two finishing heads are shown. The forging is first turned straight in the roughing head, and the finishing head is used to give the proper taper and a smooth finish. The wear on these cutter heads is practically nothing, and the cost of maintenance is a small item. The blades merely have to be removed from the dies and reground at intervals, according to the cut which they have been subject to. As many as 8,000 taper bolts have been finished without regrinding the cutter blades. Where extreme accuracy is required on straight bolts, the same method of operation is used, but for many purposes one cut is sufficient.

A specially designed grinding machine can be furnished in connection with the bolt machine, which is equipped with all the necessary attachments for grinding the blades true, either straight or taper and with a proper angle of clearance. The blades are made of the highest grade of steel.

Provision is made for a uniform flow of oil by means of a constant-speed rotary oil pump and connections. A stop cock is provided for each head, enabling the operator to regulate the flow or to stop it altogether. The cutter heads are surrounded by a large receptacle, bolted to the table, into which the shavings or chips are collected and easily removed from the front side of the machine by raising the hinged side. Underneath the shavings receptacle is an oil pan and strainer which is connected with the oil tank.

A taper of 1/16 in. to the foot has been found most desirable for bolts of this character, and has been adopted as a standard by all the plants of the American Locomotive Company and by many of the railroads of the country. The method of designating the nominal diameter or the sizes under the head of bolts in relation to their actual or threaded diameter and lengths, has been generally adopted for the reason that bolts of equal size under the head and of the same lengths can be made interchangeable and an accurate fit assured. The nominal diameter or the size under the head of a bolt also serves as a guide to definitely determine the size of hole necessary to receive a tapered bolt. In emergency cases, also, a short bolt can be obtained by cutting off the longer one which may be in stock, all of the conditions of taper and size under head being maintained. The table gives the computed sizes under the head of bolts most generally in use, corresponding with their actual or threaded diameter and of various lengths.

Table of Dimensions of Standard Taper Bolts.

Diameter under head.	Diameter of thread.	Length under head.
In.	In.	In.
25/32	¾	6
51/64	¾	9
13/16	¾	12
29/32	⅞	6
59/64	⅞	9
15/16	⅞	12
1 1/32	1	6
1 3/64	1	9
1 1/16	1	12
1 5/32	1⅛	6
1 11/64	1⅛	9
1 3/16	1⅛	12
1 13/64	1⅛	15
1 7/32	1⅛	18
1 9/32	1¼	6
1 19/64	1¼	9
1 5/16	1¼	12
1 21/64	1¼	15
1 11/32	1¼	18
1 13/32	1⅜	6
1 27/64	1⅜	9
1 7/16	1⅜	12
1 29/64	1⅜	15
1 15/32	1⅜	18

The output from this machine is very much in excess of any other method, as many as 1,000 1¼ in. x 9 in. taper bolts being rough turned and finished in 10 hours, the accurate finish of each being better than those produced by any other method except where ground on centers. The output of a good engine lathe where the operator must center, rough turn, rough off under the head, change the tool, finish under the head, and file to fit sleeve gages would probably not be over 50 in each 10 hours, or, in other words, this machine with an unskilled operator has a capacity equal to 20 engine lathes.

Walter H. Foster, 126 Liberty Street, New York, is the sole selling agent.

Four English Train Accidents.

The British Board of Trade has recently issued reports on four accidents. The first was a case on the North Eastern near Newcastle-on-Tyne where a train passed a stop signal at danger and came into collision with a train standing under the protection of the stop signal. The probable explanation of this mistake is that the driver saw the stop signal for the next tower "off" for the previous train. This particular signal is about 600 ft. further along the line and is a very high signal while the signal that he ought to have obeyed is on a shorter post.

The question may be asked why these two trains were so close together, seeing that there was only 105 ft. between the stop signal which the engineer ignored and the tail of the preceding train; so it must be remarked that at this busy point, immediately outside Newcastle Central station, the Board of Trade had allowed exemption from block working; so that a second train may be accepted from the tower in the rear even although the previous train had not been "cleared;" in other words has not gone far enough to be protected by two stop signals.

The second accident was on the Lancashire & Yorkshire. Part of an express train was thrown off the line in passing on to a slow track at too high a rate of speed. The junction is situated near the western mouth of a tunnel 3,300 ft. long. The home signals are at the junction but the distant signal is at the other (east) end of the tunnel. The distant signal can be cleared only with the home signal for the straight line and will not come off if the home signal is lowered for going on to the slow track. The train in question (westbound) had to be turned on to the slow track and so the switches were set for that line and the home signal lowered. Consequently the distant signal should have been at danger; but the engineer of the express found it "off" when he passed it. Owing to the tunnel he was unable to see that it was the other home signal that was lowered for him and although he reduced his speed he was unable to do so sufficiently and part of the train was derailed.

It is difficult to state what was the reason for the dis-

tant signal being lowered when it should not have been in that position. The Board of Trade officer proves that the signal was "off" and that there was no suspicion that the signals were changed after the engineer had passed the distant. The distant is a lower arm under the advance signal for the tower at the east end of the tunnel, and the upper (advance) arm "slots" (controls) the lower (distant) arm. At the west end of the tunnel there are two signal towers about 1,000 ft. apart. The tower nearest the tunnel being known as the East signal box and the other as the West box. Owing to the tunnel it is not possible to provide distant signals for the West box the regulation distance out, and therefore the distant signal for the East box had been controlled from the West so as to act as the signal for both the East and West towers. The arm is therefore trebly controlled, first by the advance arm above it, secondly from the East tower, and thirdly from the West, and it can be put to danger by the action of any of the three men concerned.

Some little time before the arrival of the express train another train had passed for which the distant signal had been lowered, and it is assumed that the wire working the control from the east tower got hung up in the tunnel so that when the towerman there put his lever back after the first train had passed, his slot remained "off." The arm, however, would go to danger in consequence of the action of the two other men. When the advance signal was lowered for the express and the man in the west tower pulled off his slot, the distant arm would drop. The Board of Trade officer therefore recommends that the signalmen in the towers west of the tunnel should control the distant signal electrically and not mechanically, in order that the long run of wire through the tunnel may be avoided. It will be interesting to learn whether the railroad company adopts this recommendation for, as yet, there are no cases in Great Britain where distant signals are worked by power from mechanical towers.

The other two collisions occurred on the Metropolitan and Metropolitan District underground roads. In both these cases manual controlled block working was in force, but the men at fault were able to in one case tamper with the mechanism and in the other to use the releasing key improperly, so that clear signals could be obtained when a train was already in the section. In both these cases the trains, for reasons that need not be given here, were longer in the section than usual, and this fact contributed partly to the mishap. But if the signals had been controlled by track circuit the signals there could not have been lowered.

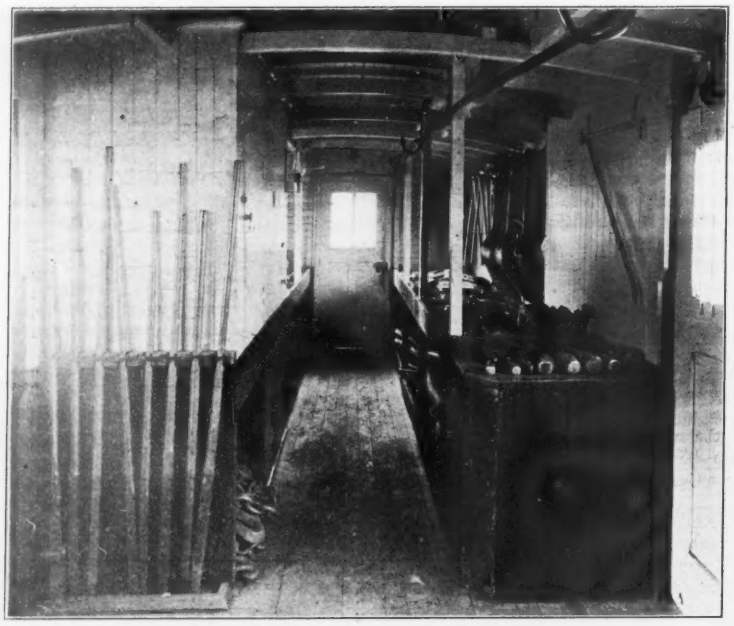
The New York Central Wrecking Outfits.

In former years there were two separate outfits in use on the New York Central lines for clearing wrecks; one for handling cars and the other for locomotives, and they were in charge of the track department. Efforts were made, of course, to reach the scene of trouble as quickly as possible after a wreck, but in view of the serious consequences occasioned by even a slight blockade on a crowded railroad it was desired to perfect the organization and put it more or less on the status of a city fire department, with men trained to the work, apparatus located at convenient places along the line and always ready to go out, and some sort of system for getting a crew together at once after an alarm was sounded, and for having each man know his station and his work.

On the New York Central lines proper, wrecking outfits organized in this way, and in charge of the car department, instead of the track department, are now located at Buffalo, Rochester, Syracuse, Utica, West Albany and New York. Orders specify that the trains shall be made up of locomotive; large flat car, double decked, equipped with outriggers, extra trucks, extra rails, etc., this car serving also as idler for the crane; steam crane, tool car, caboose and commissary. In some cases two tool cars are used. The train is equipped with air brakes and train signal pipes and the brake valve for the steam crane is located on the crane engineer's platform under his left foot, so that he can move the crane back and forth as required. The outfits, it will be observed, are all located at large yards, where a locomotive can always be obtained at short notice; hence, no special locomotive is generally set apart for the work, although the rest of the train is kept made up. A characteristic arrangement is at East Buffalo, where the crane, constituting the rear car of the train, stands in a brick shed, and is connected with steam pipes so that about 60 lbs. of steam is maintained at all times and the crane engineer is released for other duties. Several sizes of cranes are used in the different outfits. The one at East Buffalo is of 45 tons capacity, and was made by the Industrial Works at Bay City, Mich. The crane shed is used for no other purpose and is fitted with electric lights and with the piping mentioned. Alongside the track where the outfit stands is a siding on which are stored a number of extra trucks, so that vacancies can be filled promptly, and the train can always be left ready to start. Trucks recovered from wrecks and replaced by those carried on the wrecking train are generally placed on this siding when they are brought back, if in sufficiently good condition for emergency use.

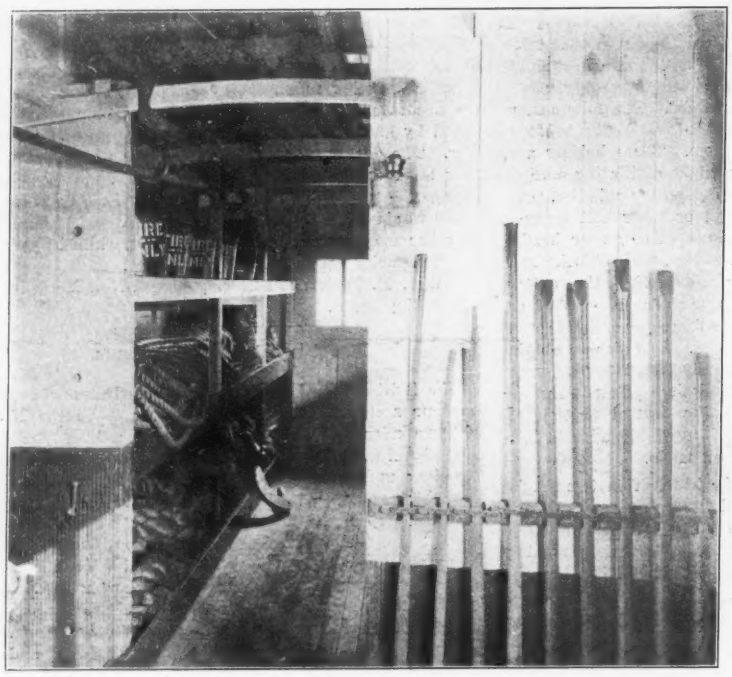
The territory covered by each outfit is approximately 60 miles each way; the Buffalo train goes as far as Rochester, the Suspension Bridge, down the Falls Road as far as Medina, to Churchville, on the West Shore, and to West Seneca, on the Lake Shore & Michigan Southern.

The organization consists of one wrecking master, assistant wrecking master, crane engineer, assistant crane engineer, craneman and five men, one of whom is a cook and also acts as steward. The wrecking master is thus in charge of eight expert mechanics who work on cars in their spare time, but are really extra men, since they are called out frequently and it is desirable to have them leave what they are doing without interrupting the work in the shops. A track crew also goes along, and there are sleeping accommodations on the boarding car for 21 men. The Buffalo train is made up slightly in excess of the requirements described above and contains steam crane and rigger car, two tool cars, one flat car loaded with engine trucks, one flat car loaded with car trucks and track materials and a boarding car, making a total of six cars and a crane. An equalizing beam is carried on the rigger car for use in lifting coaches without damaging their sides, as shown in one of the accompanying photographs. This beam is the length of a tie, and chains suspended from

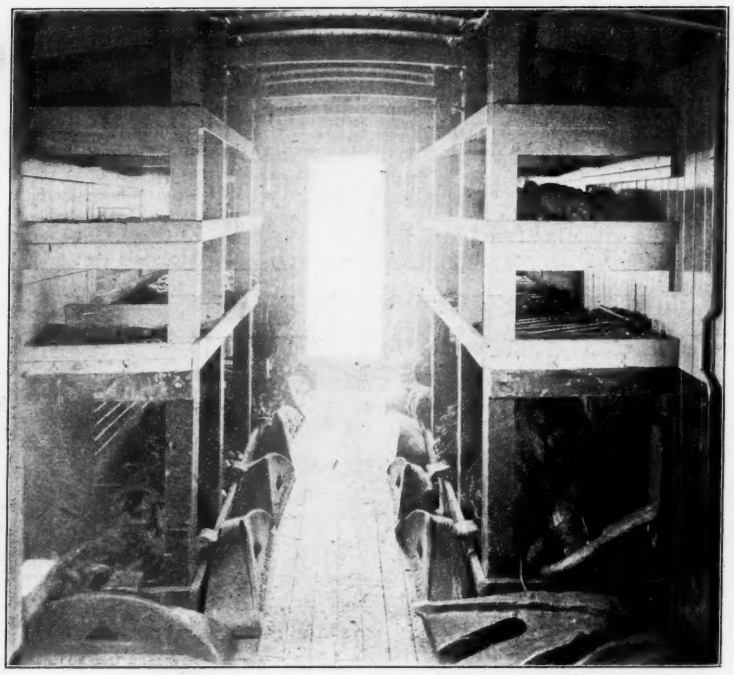


Tool Car Interior. Cutting Tools in Compartment on the Left.

Tackle, Blocking Pieces and Jacks.



Blocks and Lines.



Car Replacers, Chains and Heavy Tools.

the ends do not come in contact with the sides of the car that is being lifted.

When a call is received, the crew are notified by means of messengers, by telephone, or by an alarm bell in their homes if the call comes during the night, and the rapidity with which the train can be started out is one of the most noteworthy features of the organization. On the average, 20 minutes is required in the daytime and half an hour at night from the time the wrecking outfit is called until it is on the main track, but faster time than this is frequently made.

The wrecking master and his assistant are required to see that the tool and commissary car are always kept supplied with materials for efficient work. The wrecking master is authorized to buy necessary supplies at any time for the commissary department and to send the bills to the division engineer for payment. Great care has been taken to have the tools arranged in an orderly way in the cars so that the required tool can be found instantly when it is desired, and with this in view the tools are numbered, or stenciled lockers are provided, as shown in one of the photographs. In regard further to the duties of the crew when not engaged in clearing wrecks, the orders specify that the wrecking master and his assistant shall preferably be foremen of car repairers and that the five trained men under them shall be also car repairers, while the steam crane engineer, assistant and crane man will work in the shops, roundhouses, or car repair yards, depending entirely upon the local conditions at each place, and subject at any time to call, night or day. The crew receive one and one-half time when called out at night or or on a holiday.

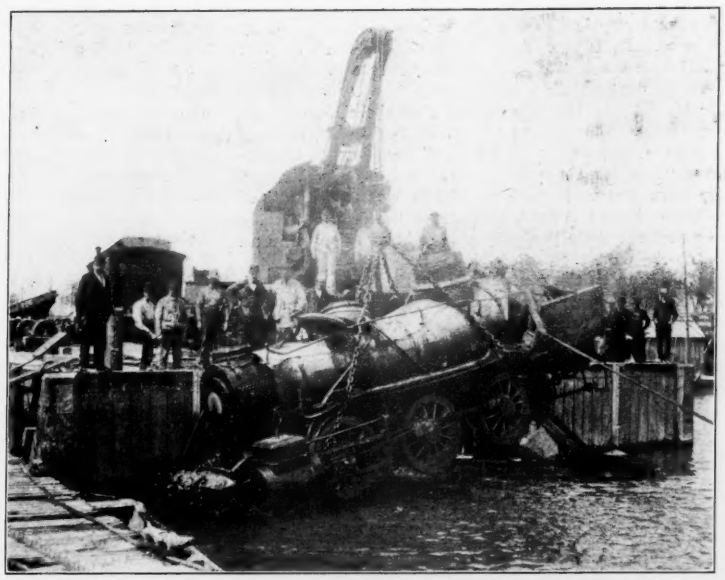
If the steam crane is away from headquarters engaged upon bridge work, the tool car, the steam crane engineer, and one man to take care of the tool car, accompany the crane. The caboose remains at headquarters, and in the event of a wreck the regular wrecking crew proceeds immediately to the wreck, where it is met by the crane. Wherever it is possible it is provided that a representative of the traffic department shall attend serious wrecks to freight trains and assist in the disposition of injured freight. When he is not present the wrecking master transfers the freight to other cars and disposes of these cars as directed by the superintendent. Special instructions have been received from different shippers in regard to handling dressed meat, etc., in wrecks, and these are filed with the wrecking master.

A complete list of the tools and equipment carried on the train is given below; as an example of the thought which has been given to details, it is worthy of note that one of the lockers contains a dozen umbrellas for use in transferring passengers from one train to another in rainy weather.

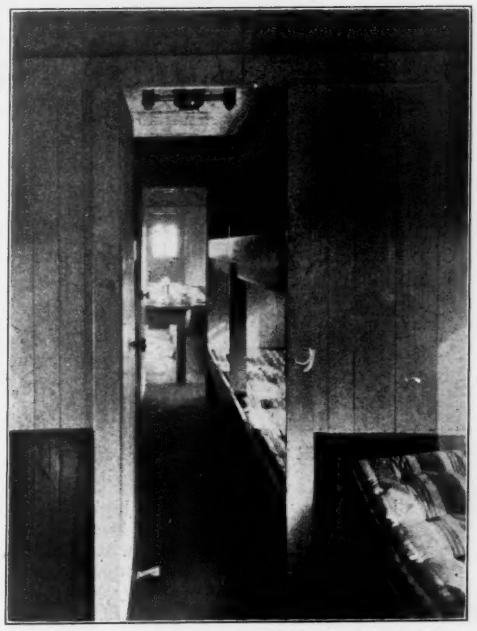
List of Tools for Standard Wrecking Cars.

4 pairs Tilden re-railing frogs for proper rail.
2 35-ton 31-in. Norton jacks, with hooks.
30-ton hydraulic wrecking jacks, with claws (Watson & Stillman 18-in. run-out).
2 20-ton hydraulic wrecking jacks, with claws (Watson & Stillman 18-in. run-out).
2 track jacks.
4 16-in. triple blocks. Two of the above blocks, together with one rope, constitute block and fall ready for use, the remaining blocks and rope being held separately as a reserve.
4 18-in. double blocks.
2 manila ropes, 2-in. diameter, each 400 ft. long. Same arrangement as above.
4 12-in. triple blocks.
2 manila ropes 1¼-in. diameter, each 400 ft. long. The above constitute two blocks and falls ready for use.
1 2-in. manila rope, 200 ft. long.
1 1¼-in. manila rope, 200 ft. long.
2 30-in. snatch blocks.
2 18-in. snatch blocks.
2 12-in. snatch blocks.
1 1-in. crucible cast steel cable 100 ft. long.
1 manila drag rope 6 in. in diameter, 50 ft. long, with hook on one end and link on the other.
2 4-in. ditto.
2 3-in. ditto.
2 crucible cast steel 1¾-in. drag ropes 40 ft. long, with hook on one end and link on the other. This is intended for special use where large engines have to be handled.
10 bumper chains.
4 ½-in. chains 22 ft. long, with rings on each end, one ring to pass through the other. Tested to 70,000 lbs.
6 Crosby cable clamps made by John A. Roebling's Sons Company.
2 crab links for 1½-in. chain.
2 crab links for 1¼ in. chain.
2 crab links for 1-in. chain.
2 crab hooks for 1½-in. chain.
2 crab hooks for 1¼-in. chain.
2 crab hooks for 1-in. chain.
4 heavy hooks and links.
2 hauling links.
4 anchor shackles and pins, 1½-in. iron.
2 "S" hooks.
2 splice links.
1 single tree cable and "L" hooks for steam crane only.
Assortment of oval and round thimbles for ropes.
1 headlight at base of boom of steam crane.
1 crane push pole.

220 pieces, wedges, etc., for blocking; assorted sizes specified, but omitted here. It is also required that about twice above amount be kept on hand to replenish car.
2 Pierson jacks and 2 Jeremiah truck levers.
2 long punches for driving out king bolts.
1 stretcher.
12 hand torches.
6 wrecking torches.
8 white lanterns.
3 Dressel station lights.
2 Sherry lights.
4 cant hooks and handles.
6 grappling hooks and handles.
10 short-handled shovels.
6 scoop shovels.
6 spike mauls.
4 adzes.
1 track gage.
4 pairs extra trucks.
4 steel rails and splices.
6 cross ties.
4 extra car knuckles.
1 extra switch (in some cases).



Raising 95,000-lb. Engine, Echota, N. Y.



Eating and Sleeping Rooms.

1 extra frog.
2 extra center plates.
6 king bolts.
An assortment of wedges and brasses.
6 extra air hoses.
6 coupling links and pins.
2 long crooked links.
4 fire buckets.
1 wheel gage.
1 16-ft. ladder.
Signal oil and cans, waste and car oil.
4 gallons alcohol for jacks.
6 pairs rail tongs.
12 track chisels.
6 claw bars.
10 lining bars.
2 hand hammers.
3 18-in. screw wrenches.
3 track wrenches.
2 hand axes.
6 chopping axes.
2 hand saws.
3 crosscut saws.
6 clay picks.
2 sledges and handles.
1 pair pole climbers.
4 pairs rubber boots.
2 pieces medium weight canvas, 20 ft. x 30 ft. for protection of perishable freight removed from cars in stormy weather).
10 lbs. dynamite, caps and fuses (carried only where rock slides are expected, but obtainable, if desired).
2 kegs of track spikes.
1 keg of track bolts of the sizes used on the division.
50 lbs. 8-in. boat spikes.
½ lb. assorted nails.

This list has been given with great fullness, not so much for the interest it possesses to the casual reader as for its actual value in the organization of similar outfits elsewhere. It has been prepared with great care, and is probably as complete a list of the necessities and utilities of a wrecking outfit as any which has been published.

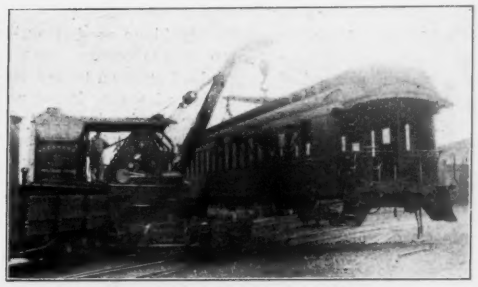
We are especially indebted to Mr. A. T. Hardin, Engineer Maintenance of Way; Mr. James Macbeth, Master Car Builder, and Mr. T. Dawson, Wrecking Foreman, for information and photographs supplied.

Increased Resistance of Spikes to Drawing.

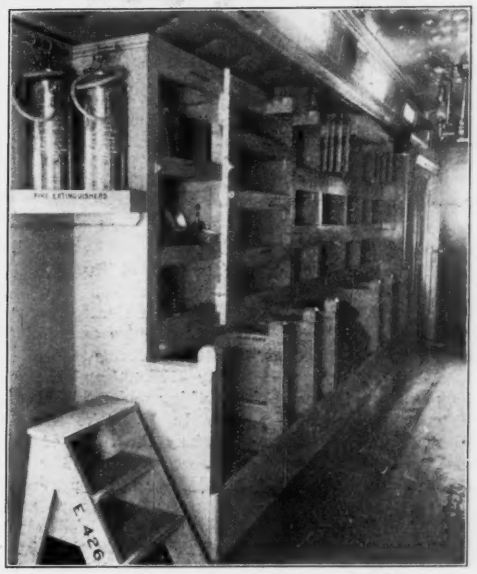
W. Fridericia, Chief of the Technical Department, Danish State Railways, has been granted patents on a method of securing spikes more securely in sleepers by means of hardwood bushes inserted into the sleepers and into which the spikes are driven. The accompanying engravings show the details of his method. Holes are bored in the sleeper having the same diameter throughout their depth. The hardwood bush is turned to a diameter a little larger than the hole and with a slight swell at the top. This is driven home in the sleeper and the spike afterward driven into the bush lengthwise of the grain instead of across the grain as it would be if driven directly into the sleeper. The length of the bush is made equal to the length of the prismatic shank of the spike.

Several years ago Mr. Albert Collet, a French engineer, patented a form of screwed bush to accomplish the same purpose. A round hole was bored with an auger in the sleeper and then tapped out. A wood screw bush was inserted in the hole and the spike driven home through the bush. A form of screw spike was later introduced and the combination of screw spike and bush has been extensively used in France and elsewhere on the continent. A number of plants have been erected in France for the manufacture of these screw bushes and recently branches have been established for the same purpose in Bavaria.

In experimenting with this type of screw bush on the Danish State Railways, Mr. Fridericia found that better results were obtained with a smooth bush held in place by the compression due to the displacement of the spike. A comparative test of the resistance of spikes to drawing when driven in the sleeper and in the smooth and screwed bushes showed that the resistance of the spike in the screwed bush was 77 per cent. greater than when driven directly in the sleeper and when driven in the smooth bush the resistance to drawing was increased 96 per cent. These tests were made using the same material for sleepers and bushes and were conducted

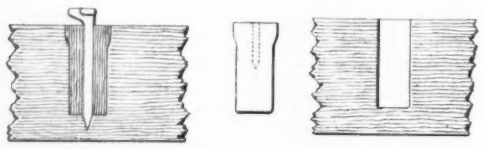


Raising Coach with Equalizing Beam.



Mott Haven Car, Showing Tool Bins.

under as nearly as possible similar conditions. In the experiments, Baltic pine sleepers treated with Rutgers zinc chloride and crude creosote process were used, and the bushes were made of creosoted beech-wood. Tests were also made with beech-wood sleepers treated with heavy tar oil and with untreated oak sleepers, using the



Smooth Bush for Spikes.

same bushes, and even in the case of these hard wood sleepers the resistance of the spikes to drawing was increased 80 per cent. The holes in the sleepers may be bored before treatment, and if this is done the wood is well impregnated around the hole which adds to its life. When the spike is driven into the bush the compression forces some of the preservative held in the bush, into the sleeper around the hole.

This form of bush can be easily applied to new sleepers or to sleepers removed from the track on account of decay around the spikes. The decayed wood is removed and a bush driven in, giving the sleeper a much prolonged life. A stretch of track near Copenhagen, over which many fast trains are run, has been laid with sleepers fitted with these bushes, some of the sleepers being new and some having been relaid. No tie plates have been used. The trial has lasted over a year and observations taken continuously show that none of the spikes have shifted laterally and no wear of the bushes has taken place, nor has there been any depression of the flange of the rail where it rests on the bushes. The trial has been successful in every way.

Traffic Development on the Detroit & Mackinac.

The history of the Detroit & Mackinac road, running along the shore of Lake Huron in the eastern part of Michigan, is the record of a very dead railroad turned into an alive and prosperous one. Good railroading is not necessarily a question of magnitude, for the development of a region, the establishing of new industries in it, and thereby securing permanent and profitable traffic for what formerly was a worked-out lumber road is as much of a triumph, of its kind, as larger results obtained from larger operations.

The first section of what is now the Detroit & Mackinac was known as the Tawas & Bay Counties, and was opened in 1878, running from Tawas City due west to Prescott, 21 miles. It was narrow gage, 3 ft. 2 in., and was designed entirely to open up lumber country. Logs were hauled to the little settlement known as Tawas City on the shore of Lake Huron and then sawed and carried to Detroit or other points by water, for there were no rail connections. In 1881, three years after the line was first opened, it worked a total of 28 miles and owned two engines and 100 log cars. Russell A. Alger, of the Alger-Smith Lumber Company, was President. In that year the freight earnings were nearly $26,000, and there were also passenger earnings of $2,500. Net earnings were slightly over $12,000.

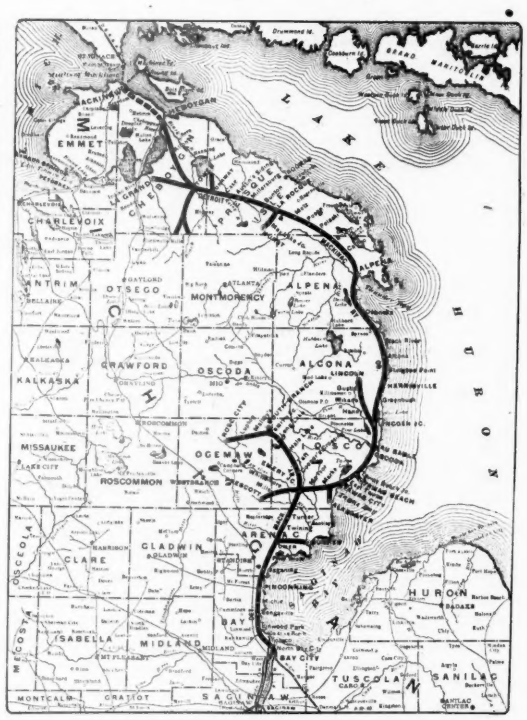
The next step in the history of the road was its reorganization in 1883 by the charter of the Detroit, Bay City & Alpena, as successor to the original Tawas & Bay Counties. In December, 1883, a connection was built through to a junction with the Michigan Central and the town was named Alger; the road was also extended the other way to Au Sable, giving a total mileage of 48. In 1883 freight earnings were nearly $118,000 and the road did a passenger business of something under $6,000 with total net earnings of $43,000. In 1888 the line had reached Alpena, running close along the shore of Lake Huron through undeveloped lumber country. The gage in 1886 was changed to 4 ft. 8½ in. and a number of branches had been built, mostly for logging purposes, with the intention of dismantling when the lumber gave out. The year 1888 was one of the best in the history of the lumber road. There was plenty of lumber and with an equipment of 17 engines, 650 freight cars and five coaches the road did a freight business of $341,960; a passenger business, including mail and express, of over $100,000; and showed net earnings of $160,000. At the close of 1888 4 per cent. dividends on the stock had been paid during the year and the road carried forward a current surplus of $10,432 in the year's operation, with a total surplus of $30,000. The mileage then worked was 197.

In 1890, 209 miles were worked and a freight business of $409,034 was done, although the passenger business had fallen off somewhat. No dividend was paid in that year and from that time on the fortunes of the road as a lumber property declined rapidly with the working out of the lumber country, so that in 1893 the earnings were so much less that the road was unable to meet its obligations. Default in payment of interest was made in July of that year. A receiver was appointed in October and the road was sold under foreclosure in 1894 and purchased for $1,000,000 in behalf of the bondholders, who organized the existing Detroit & Mackinac company in December, 1894, and began operating the road in February, 1895.

The question which confronted the bondholders at the time of this second reorganization was what could be done with a worked out property which was earning less and less each year and had no particular prospects, that anybody could see. The only outlet or inlet for traffic, except by water lines connecting with some of the ports, was through the Michigan Central at Alger, and the road found itself in the unfortunate position of being entirely dependent for through business upon a single road with which it in a measure competed and which was not much interested in its existence or prosperity. The advice given by Mr. Hawks, the incoming President under the new management, was to do one of two things; to tear up the rails and sell them for scrap iron or to raise a little more money and remove the southern connection from Alger to Bay City. The bondholders were sceptical but the President was firm. He believed that he could develop enough business on the shores of Lake Huron to pay the costs and he convinced the bondholders.

When the connection was built to Bay City the first and great gain was the independence which resulted in the possession of a terminus reached by three competing lines; the Michigan Central, the Pere Marquette and the Grand Trunk, all of which reached Bay City, and the salvation of the Detroit & Mackinac came first of all from playing off the competitors against each other in such a manner as to secure very low through rates instead of exceedingly high ones. In former days, rates on the lumber road, owing to the single through connection, were so high that nobody really took the road seriously as a transportation route for freight. In the summer time there was a transient irregular steam service from Detroit to Tawas City and Alpena, and at the approach of the close of navigation supplies for the winter were hauled by water and every barn and warehouse at Alpena was stored full of this water hauled freight, in spite of the fact that there was a railroad there perfectly able to bring supplies in all through the winter.

But as soon as the connections south were established, the Detroit & Mackinac freight rates went down with a run, and the railroad thereafter carried freight and



The Detroit & Mackinac Railroad.

supplies all winter, as they were needed. The steamer service still remained an annoyance, and the freight agent of the railroad received instructions to put it out of business. No questions were asked him about rates, but the rail carrier beat out the water carrier, and disposed of the competition quickly and effectively. This provided for old traffic; the next thing to do was to secure new traffic. The former business was almost wholly lumber and forest products, and in 1897, the year following the completion of the extension through to Bay City, forest products constituted about 87 per cent. of the total tonnage movement, and there was not much for the back haul.

In 1898 the haul of bituminous coal, which had previously been quite unimportant, was considerably more than doubled. After the close of the fiscal year a shaft was started in the vicinity of Bay City, and in 1899 over 10,000 tons were carried, as against 3,600 two years before. The development of this traffic was rapid, and this year nearly 100,000 tons were carried, constituting over 11 per cent. of the total freight business, where bituminous coal in 1897 amounted to only about four-fifths of 1 per cent. This was the first important traffic, other than lumber, which the reorganized road secured, and with the growth of industries along the road, it promises to be permanent in its character and to show good increases year by year, while at the same time it furnishes a back haul.

By 1898 the supply of pine timber, which the road was originally built to handle, was practically exhausted, and without its new business and southern terminal, it would have been about time to tear up the rails and sell them for scrap. But it was found that there was enough hardwood in reach to more than compensate the loss in pine; enough to keep things going while more industries were being developed, and that the hardwood, unlike the pine, was all on good farming land, so that, as in the case of the Gulf & Ship Island road, described in a previous issue of the *Railroad Gazette*, it was evident that the timber traffic would gradually be supplanted by farmers' crops. New branches were built into the hardwood country, and in 1900, 51,500 tons of lumber were hauled, as against 28,000 in 1897, while the traffic in forest products other than lumber, shingles, staves, pulp material, etc., amounted to over 629,000 tons, as compared with 358,000 in 1897. In 1900 agricultural products carried amounted to 26,000 tons, as against 6,000 in 1897; that is to say, a nice little traffic had been built up from practically nothing at all.

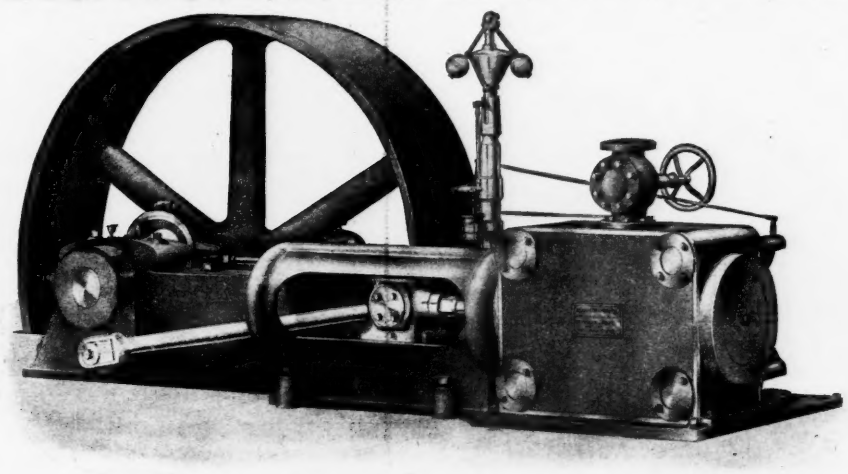
It was found that there were abundant deposits of limestone tributary to the road, and the development of this business has been perhaps the most interesting part of the traffic secured. There had been for some years a plant at Alabaster, on the northern shore of Saginaw Bay, which manufactured cement, plaster, etc., and shipped by water to Chicago, Cleveland and Buffalo. But the high local rate from these points to the places where the products were consigned so affected the through rate, in spite of the water haul, that the Detroit & Mackinac was enabled to secure quite a large share of the business, and to-day carries from the Alabaster works an amount of freight greater than their entire output of three or four years ago. Over 78,000 tons of limestone and gypsum products, stone, sand and other articles of like nature were carried in 1903; not a great figure as railroad freight traffic goes, but interesting in comparison with the 3,200 tons of the same, carried six years previous.

So far nothing has been said about the development of a passenger traffic. In the early days of the Tawas & Bay Counties and of the Detroit, Bay City & Alpena a little business was done with the very limited equipment at hand, but it did not constitute a very important feature of operation. A time-table is printed in the Official Guide in 1884, the year following the charter under the name of the Detroit, Bay City & Alpena, and the building through to a junction with the Michigan Central at Alger. One through train was run daily in each direction between Alger and Au Sable, 48 miles, in 2½ hours. When the line was opened to Alpena, two years after that, two trains were run daily between Alpena and Alger, 105 miles, and the running time of the express was 4¾ hours. The other train was made up chiefly of freight cars, but carried a coach. Apart from the local passenger traffic between points on the road, it was an easy route to good hunting country, and the new management in 1894 saw the possibilities of this and also the chance of developing summer resorts at the Bay City end of the line, sufficiently near Detroit so that they would be available for commutation traffic. The President managed this part of the business, the opening up and advertising of summer resorts and the maintenance of a popular service, in much the same way that he was accustomed to successfully manage his electric railroad, understanding the profit in frequent service, low rates and plentiful advertising. The road passed through a country particularly well adapted for this sort of thing, along the picturesque shore of Lake Huron; and the company built cottages, renting them for the season, developed picnic grounds, and did not hide its light under a bushel. In 1896 the passenger earnings of the road were $73,123, but by 1900 they had considerably more than doubled. The following year, through a considerable reduction in rates, the passenger earnings fell off slightly, but a much larger number of passengers were carried than the year previous, and in 1902 the results were somewhat the same; but in the fiscal year ended last June the total passenger earnings amounted to nearly $245,000, including mail and express traffic, and the revenue from passengers alone was about $211,000. The through hunting traffic and the short-haul excursion traffic so balanced each other in the current fiscal year that the passenger earnings in December were greater than in any month in the summer, with August second best and March next. A through sleeping car is run from Bay City up into the hunting country in the neighborhood of the Straits of Mackinac and the day trains have a parlor car to encourage sportsmen's traffic.

No mention has been made of the engineering features of the road, because, although good work has been done, its interest is quite subservient to that of the traffic gains made by a worked-out lumber road, in comparatively unknown country, with no single marked source of revenue to compensate it for business loss by the failure of the pine timber for which it was originally built; but grades have been reduced to permit the hauling of long trains, the road has a large number of 80,000 lb. capacity cars for use in the coal traffic, substantial bridges have been built, and the track has been kept up in good condition. The rail on the main line, between Bay City and Alpena, formerly of 50 and 52 and 56-lb. section, had all been replaced with 70-lb. rail when the 1900 report was issued, and the heavier rail has since been put in on some of the extensions. Almost all of the improvement work, however, including most of the equipment bought, was paid for out of earnings, with the result that the bonded debt was less in 1903 than in 1896, although gross earnings had more than doubled in that period.

A New Design of Corliss Engine.

The Allis-Chalmers Co., Milwaukee, Wis., has brought out a new Corliss engine shown in the accompanying illustration. The field of Corliss engine design has been so fully worked over in late years and the accepted modifications and types have been so simplified and perfected that no striking improvements are to be expected in new engines. This engine, however, which has been worked out from the designs of Irving H. Reynolds, combines



Allis-Chalmers Corliss Engine.

many of the desirable features of other and older types of engines and the result is a machine well adapted to general mill work and power generating stations. It is built in seven sizes from 50 to 500 h.p., and for steam pressures up to 150 lbs. The stroke is shorter than that usually employed in Corliss engines of similar power, with the idea of economizing space and making possible a more rigid construction. The speeds are also higher than usual practice, ranging from 110 to 150 r.p.m., although some older designs of Reynolds-Corliss engines are frequently run at these speeds.

The frame is cast in one piece with the cross-head slides, and rests directly on the foundation over its whole length. The main bearing shells are bored into the frame which gives a solid bearing and permits their easy removal by rolling them out around the shaft. Babbitt-faced shoes with wedge adjustment are fitted to the cross-head and the piston rod is screwed into it and held firmly with a steel lock-nut. The cross-head slide is the barrel type with bored guides. The steam and exhaust valves are double-ported and are lagged with planished steel. A cast-iron base plate on which the cylinder rests, extends out under the valve gear and forms a drip-pan.

A modified form of the Reynolds-Corliss valve gear is employed which has a skeleton wrist-plate and a new form of disconnecting device which, while clamping the hook rod firmly, is easily detached by hand. The differential plunger dash-pots are without leathers or packing of any kind. Close regulation of speed is secured with a high-speed weighted regulator designed to control the engine within narrow limits.

The connecting rod is of steel with solid forged ends, fitted with bronze boxes, lined with babbitt metal on the crank pin ends and adjusted with screw wedges. A planished steel oil guard, not shown in the illustration, is fitted around the crank. The engine is built either with a belt fly-wheel or with a square rim wheel if intended to be directly connected to a generator or other machine.

The Caskey Hydro-Pneumatic Punch.

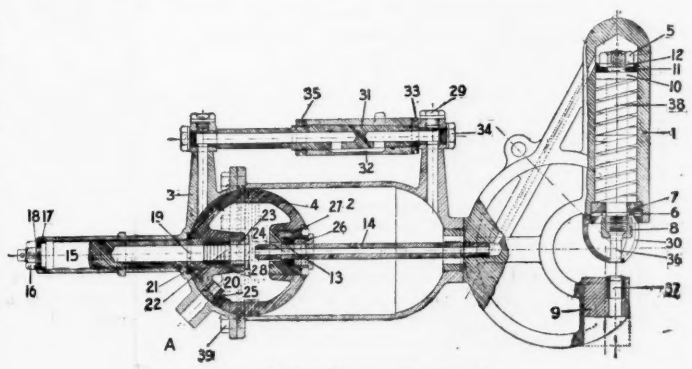
The first Caskey punch ever built, though crude in design compared to the device now on the market, punched 90 per cent. of the holes in two torpedo boat destroyers. Two years later the tool was placed on the market, the interim being devoted to perfecting and improving it. Portability, speed, accuracy, lightness of weight, and convenience are some of the advantages claimed for it.

In the illustration the ball piston, 4, carrying a tail rod or intensifier, 15, is in extreme rearward position, the extremity of the stationary hollow rod, 14, being at the approximate center of the ball piston. When the piston begins its stroke, receiving air pressure through A, the rod 14 telescopes into tail rod 15, and seals all communication between the tail rod and the interior of the piston proper. As the piston and rods are kept filled with oil, the air pressure back of the piston is concentrated upon the column of oil contained in rod 14, and the passages leading to the punch ram chamber. The volume of oil moved at each stroke is just sufficient to depress the punch, 36, the proper distance, and as soon as the hole is punched no further downward motion is possible. All jarring and undue strain on the parts is thus prevented, and a steady, yet positive action secured.

When the piston has completed its working stroke a slight turn of the valve 32, admits air to the other end of the cylinder, equalizing the pressure on both sides of the piston; but the area of the stationary rod 14 being less than that of the tail rod 15, the piston is forced back into position for another stroke. A considerable saving in air is effected by this arrangement, the same air being used to drive the piston in both directions.

Owing to the peculiar construction and arrangement of the ball piston and parts it is impossible for any air to get into the high-pressure passages, unless the oil level in the piston is permitted to fall below the top of opening in the tail rod; in which case the piston should be refilled at once.

In the construction of the tool a special alloy of aluminum is used wherever possible, to reduce its weight to a minimum. It is marketed by the Chicago Pneumatic Tool Company, Chicago.



Caskey Hydro-Pneumatic Punch.

Foreign Railroad Notes.

The new Opladen locomotive repair shops begin with a force of 800 men, which is to be increased gradually to 2,000. The house accommodations for the workmen have had to be built, for the most part, as well as the shops.

At the end of September there remained 8,188 ft. of the Simplon Tunnel to be excavated. The head of the tunnel from the north end had then passed the central point by 360 ft. The flow of water in the south end continues very large but has decreased somewhat.

The number of times daily the track is walked by the roadmen in the German Railroad Union is reported as usually three or four on main lines, and in a few cases six times. On branches, etc., the track is usually walked once or twice.

The Belgian railroad authorities have an Index Epurgatorius of publications which may not be offered for sale at the book and news stalls in stations. There are 63 titles in this index now, the 63rd being a Paris journal, which was too nasty.

A commission appointed to suggest improvements in the passenger and baggage cars of the Prussian State Railroads has recommended that experiments be made in the use of dry or superheated steam for heating cars, by those lines which have locomotives with the Pielock superheating construction. Experiments aiming at a smoother movement of four-wheeled and eight-wheeled cars are to be continued. A car on trucks, American style, should be provided, and exact calculations made of the action of the springs in the various truck constructions most commonly used. Designs for six-wheel and eight-wheel compartment cars with ventilators over the side windows (as in the long cars with passage from end to end, now common on German through trains) should be made when contracts for such cars are to be let. The journal boxes of the middle axle of six-wheeled cars should be lengthened, giving more lateral motion. Favorable results with what are known as the Eckstein steel axle boxes justify further trials on a considerable number of cars, assuming that the manufacturers remedy a defect in facility of lubrication.

TECHNICAL.

Manufacturing and Business.

The Topeka Bridge & Iron Manufacturing Company, Topeka, Kan., has been incorporated with a capital stock of $25,000.

The Independent Railroad Supply Company, Chicago, has recently shipped a number of car loads of "Chicago" tie plates to the Indiana Harbor R. R.

The sale of the United States Locomotive Works of Hammond, Ind., now in the hands of a receiver, has been postponed by order of the court until Dec. 10.

The Continuous Rail & Manufacturing Company of Augusta has been incorporated with a capital of $2,000,000, in Maine. J. Berry and A. M. French are incorporators.

The roundhouse of the Baltimore & Ohio at Keyser, W. Va., having 22 stalls, has been equipped with "Giant" cast-iron smoke-jacks made by Paul Dickinson, 143 Fifth avenue, Chicago.

The branch office of the Walter A. Zelnicker Supply Company at Houston, Texas, has been removed to 603 Binz building. H. E. Miller, for many years in charge of this office, will continue as Manager.

The Amberson Manufacturing Company, of Cincinnati, Ohio, has been incorporated with a capital of $10,000, to make bolts and nuts. Lenton R. Amberson, Morgan Van Matre and others are incorporators.

The Hayes Track Appliance Company of Geneva has been incorporated in New York, with a capital of $50,000, to make railroad appliances, by Stanley W. Hayes, Lansing G. Haskins and Ray S. Messinger, incorporators.

The Pressed Metal Manufacturing Company has been incorporated in New Jersey, with a capital of $150,000, to make pressed metal wheels. The incorporators are E. A. S. Lewis, Henry Rowland and J. Warren Bird, all of Hoboken, N. J.

The Coffin-Megeath Supply Company, Franklin, Pa., informs us that the McLaughlin flexible conduit, made by that company, has recently been made standard on the Harriman railroads for steam and air connections between engine and tender.

The Industrial Water Company, 126 Liberty street, New York, has closed a contract with the Singer Manufacturing Company for the installation of one of their water softening and purifying machines. The plant is to have capacity to treat 20,000 gallons of water per hour, and is to be installed at South Bend, Ind.

A charter has been granted the New Bethlehem Terminal & Bridge Company in Pennsylvania. The company is to build and maintain a steel bridge over the Lehigh River between Bethlehem, West Bethlehem and South Bethlehem. The incorporators are Truman M. Dodson, Clarence A. Woole, G. B. Linderman and others.

The New York Continental Jewell Filtration Company has recently sold pressure and gravity filters to the Salem Water Supply Co., Winston-Salem, N. C.; City of Winston, N. C.; Springfield Gas Light Co., Springfield, Mass.; L. L. Brown Paper Co., Adams, Mass.; F. J. F. Lovejoy, Pittsburg, Pa.; Fleischmann & Co., New York; White Swan Laundry, Wheeling, W. Va.

The Northern Engineering Works, Detroit, has lately sold electric cranes of from five to 25 tons capacity to Gerst Bros., St. Louis; Olds Gasoline Engine Works, Detroit (three cranes); Omaha & Council Bluffs Ry. Co.; American Steel & Wire Co. and Green's Car Wheel Company; and hand power cranes to Cambria Steel Co., Jackson & Church, and the Indianapolis & Cincinnati Traction Co.

The Manufacturers Railway Supply Company, Chicago, maker of the Interlocking driver brake-heads and brake-shoes and of Interlocking car shoes, announces that hereafter these products will be sold exclusively by that company and no agents are authorized to solicit orders. All salesmen will be under the direct supervision of the home office. The company has acquired a controlling interest in an up-to-date machine-moulding foundry having an annual capacity of 20,000 tons, and in future the manufacture of the devices above mentioned will be under the supervision of the Vice-President of the company.

Iron and Steel.

The Sweet Steel Company, it is reported, has begun work on its new mill at Dodge's Island, near Williamsport, Pa.

Reports state that a merger of the Whitaker Iron Company, Wheeling Corrugation Company of Wheeling, W. Va.; the Laughlin Nail Company, Martins Ferry, Ohio, and the Portsmouth Steel Company of Portsmouth, Ohio, is about completed. The new name under which they will be operated is the Whitaker-Glessner Company.

Reports from Birmingham state that the Tennessee Coal, Iron & Railroad Company is producing more iron, with four furnaces in operation, than has ever before been made with the entire five. Furnace No. 4 is undergoing repairs, No. 6, which is the largest of all, is nearly completed. Two of the 18 blowing engines being put in by the Mester Machinery Company are about completed and will shortly be put in operation.

The Life of Friction Draft Gear.

Draft rigging is one of the weakest members in the whole system of understructure or under-framing of a car. Today with our largest cars the draft riggings are unable to stand the shocks given to them, notwithstanding the

fact that we have friction draft rigging. These friction gears are playing out much more rapidly than we ever had any reason to expect. They will stand enormous shocks; they will stand all kinds of hard usage; and suddenly something gives in and you have to scrap practically the whole thing or else rebuild it.—*Willis C. Squire before the St. Louis Railway Club.*

Extensive Dredging.

A large amount of river and harbor improvement work is now under way or soon to be begun by the government. At present, 10 suction dredges are being built, two of which will be sent to the Great Lakes, two to New York Harbor, two to the Mississippi River, two to Charleston, one to Galveston and one to Savannah. Five of these are being built by the Maryland Steel Company, two by the James Reilly Repair & Supply Company, and one each by the W. R. Trigg Company, the Petersburg Iron Works Company and the New York Ship Building Company. The mechanical equipment of the dredges for salt water service will include surface condenser outfits with Blake air pumps, feed pumps, fire pumps, etc. The dredges for the Great Lakes are provided with very large Blake cross-compound, double-acting, air pumps and jet condensers with the usual complement of Blake vertical duplex feed pumps, fire pumps, etc. The air pumps are of a novel arrangement. By the manipulation of valves and cocks each pump can be cut in two and one side run independent of the other. This practically provides a spare pump in each installation without the necessity of being overweighted with duplicate machines, and at the same time the advantages of compound steam cylinders are secured. These dredges are the largest in capacity ever built and are specially designed. They are self-propelling, sea-going dredges. Some of these vessels are fitted with immense bins in which the dredged material is deposited, and when full, the vessel propels itself to deep water, dumps the sand or mud and steams back to repeat the operation. Others are arranged for depositing the dredged material into large scows fastened alongside the vessel.

THE SCRAP HEAP.

Notes.

W. S. Carter, Editor of the *Firemen's Magazine*, has been chosen by the Grand Trustees to be Secretary and Treasurer of the Brotherhood of Locomotive Firemen, succeeding Mr. Arnold, who has resigned. George W. Goding has been appointed editor of the magazine.

The Texas Railroad Commission has decided to adopt a general classification of freight rates for the State of Texas to succeed the western classification.

The railroads operating between Chicago and the Atlantic Coast have decided to add steel rails to the list of steel products to be included in the reduction of 33⅓ per cent. in the rates on shipments intended for export. The reduction takes effect December 1.

The Foreign Trade Association of America, recently incorporated in New York, has adopted a resolution declaring that a special export freight rate on iron and steel to the exclusion of other manufactured products is unjust; and a committee will be appointed to seek a remedy.

In the United States Court at Savannah Nov. 25 contempt proceedings were begun against President Smith, of the Louisville & Nashville; W. Hale, Superintendent of the Fourth Division of the Seaboard Air Line, and W. B. Denham, Superintendent of the Second Division of the Atlantic Coast Line, ordering them to show cause Dec. 14 why they should not be punished for disregarding the order of the court. The case is that of the Inter-State Commerce Commission, in which it is claimed that the rates on cotton and rosin to River Junction, Fl in conjunction with the rates from that point to Savannah were so high and so unreasonable as to be prohibitive. On July 21, Judge Speer sustained the contentions of the Commission but the railroads have paid no attention to the terms of the decree, and so the Commission filed complaint.

State Railroad Operation in Switzerland.

The Swiss Congress has its time largely taken up by railroad questions, since the acquisition of the chief systems by the State. The settlement of the hours of work and rates of pay of the employees was, of course, a delicate matter. All kinds of improvements are demanded by the public—more trains, faster time, lower rates, etc.; but Mr. Zemp, the Manager for the confederation, resists many demands which would reduce profits, though the changes in hours, etc., will require an increase of 1,155 employees in 1904. Recently the question has come up how far new construction by companies or cantons may be permitted, when the lines contemplated may compete with the State lines. The promoters of the new lines would like to be protected against competition by the State lines; but they are not always willing to refrain themselves from competition with the State lines. The State authorities declare that no new construction of importance can be undertaken by the State for some time to come.

Light Passenger Cars.

The Austrian State Railroad management is aiming to secure a reduction of expenses on the local railroads worked by it by introducing passenger cars which weigh only 12,500 lbs. in place of the prevailing types which weigh at least twice as much. The new cars have seats for 38 third class passengers, with a dead weight of 330 lbs. per passenger; against 640 lbs. in the old cars. An ordinary train for these railroads (which for the most part have a very light traffic) will consist of a locomotive weighing 34,750 lbs., a mail and baggage car, 14,000 lbs.; a passenger car with second and third class compartments, and another carrying third class passengers only, weighing together 25,300 lbs., with seats for 74. The whole weight of the train will be 60 per cent. less than that of the existing trains, and will carry only 10 fewer passengers. Moreover, the new train costs but $8,600; the old one, $12,200. It is many years since there has been much serious effort to reduce the weight of passenger cars, and no such weights as those mentioned would be thought of for high speeds.

Trying to Regulate Freight Speed by Law.

The Russian railroads, as usual after a good harvest, have been unable to carry all the grain offered, which accumulates at stations at a fearful rate. An official journal intimates that part of the trouble at least is due to the length of time the grain is on the road. The regulations allow two days at the shipping station, one at the delivery station, a day at each transfer from one railroad to another, and a day for every 100 miles hauled. For a shipment from an interior market to the Baltic port Reval, 1,023 miles, this allows 18 days, there being four transfer junctions on the route. Thus the grain must get to its destination at an average speed of less than 2½ miles an hour. It is not to be supposed, however, that the railroads always take all the time the law allows for moving the grain. They are interested in moving all the freight they can get in the shortest possible time. Apparently they are easily blocked, whether for lack of appliances, sidings and rolling stock, or for incapacity in the working force cannot be said without study on the spot. The ministerial organ proposed that only one day be allowed at the shipping station, 12 hours at the receiving station, six hours at transfer junctions, and one day for every 200 miles hauled.

Heavy Freight Traffic in Kansas.

After the most aggravating delay ever known western Kansas wheat is at last moving. Since harvest every road in that region has been congested with wheat. At every western Kansas station elevators were full to the roofs and heaps of grain, 20,000 to 60,000 bushels in a pile, were lying under the open sky, dumped on the buffalo grass sod.

All sorts of ruses were resorted to in the effort to obtain cars. Tips to brakemen and freight conductors were found to have a good effect, and where roads paralleled each other within 30 or 40 miles farmers transferred their business, going in long strings of teams across country. This would bring the home road to terms. But hundreds of cars were sidetracked and shipments were a month on the way from western Kansas to Kansas City. Some dealers were ruined by the market changes in the interim. Now the railroads are importing big engines from other divisions, and are hauling 50-car trains to market with some show of lessening the glut. The Kansas Grain Men's Association [Nov. 17] passed resolutions condemning the railroads for dilatory movement. It also declared that the estimate of 90,000,000 bushels for the State's yield was too high. It is estimated at 80,000,000. Other authorities do not agree with this low figure.—*New York Evening Post.*

An Eminent Sociologist on Every Train.

The signs now indicate that the race issue between the two great parties will reach a more clean-cut phase in the railroad world than elsewhere, and the point at which the line will intersect will be the "Jim Crow" car. In Maryland, which is a border State, and therefore good fighting ground, the Democrats are discussing legislation requiring separate accommodations for negroes and whites on the same trains, such as are found on Southern railroads generally. If the Maryland Legislature should enact such a law, an attempt would be made to enforce it, of course, on the Pennsylvania and Baltimore & Ohio Railroads between the New England and Middle Atlantic States and the District of Columbia. If the Jim Crow faction should prevail, every through train from Boston, New York, or Philadelphia to this city would be compelled, on reaching the Maryland boundary, if not before, to take on an extra car, divided into compartments for white and colored passengers respectively, or an exclusively negro car. What is more, the law would be as strictly enforced against whites riding in the negro compartments as against negroes riding in the parts of the train exclusively set apart for Caucasian use. Every conductor would be held responsible for violations of the law. As it takes a residence of several years in the South, and constant contact with the negroes and mixed-bloods, to enable the most intelligent person in other walks of life to distinguish between certain erratic mixtures and the pure Caucasian race, every conductor would have to be what President Roosevelt denominated Conductor E. E. Clark of the Anthracite Arbitration Commission—an eminent sociologist.—*Washington Correspondent, New York Evening Post.*

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular mettings of railroad associations and engineering societies see advertising page xvi.)

Railway Club of Pittsburg.

At the meeting of this club held at Pittsburg, November 27, the paper read and discussed was "The Essentials of a Modern Railway Paint Shop," by W. O. Quest, Master Painter, of the Pittsburg & Lake Erie.

PERSONAL.

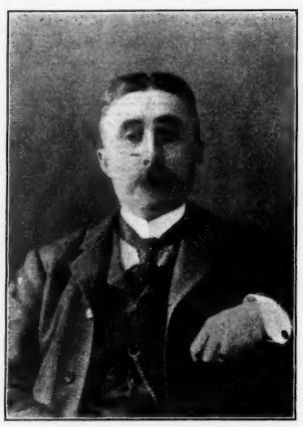
—Mr. Andrew H. Pride, for many years General Eastern Freight Agent of the Chicago & North Western in New York City, died in New York City Nov. 24.

—Mrs. George W. West, wife of the Superintendent of Motive Power of the New York, Ontario & Western, died at her home in Middletown, N. Y., on the night of November 21. Mrs. West's death was due to pneumonia and her sickness lasted only ten days.

—Mr. George W. Waite, for many years a well known citizen of Chicago, died in that city last week at the age of 84. In 1848 Mr. Waite was Assistant Engineer of the Galena & Chicago Union Railroad and took part in the work of laying the first track, which was at Halsted and Kinzie streets, Chicago.

—Mr. Thomas N. Hooper, President of the Colfax Northern Railroad, died at his home in Des Moines, Iowa, Nov. 24. Mr. Hooper was 37 years old and began his railroad career as a clerk on the Rock Island. When the Chicago Great Western was established he went to that company, and, in 1890, was appointed Division Freight Agent at Des Moines. In 1898 he was promoted to the office of Assistant General Freight Agent, but two years later resigned and bought an interest in the Colfax Northern and in the coal mines along the line of the road.

—Mr. H. R. Dering, Assistant General Passenger Agent of the Pennsylvania Lines West of Pittsburg, died at his home in Chicago, Sunday, Nov. 29. He had not been actively in charge of his office since August, and during his last weeks was confined to his home, gradually failing in strength. Mr. Dering was born Dec. 17, 1848, and began his railroad career in 1871. During his 32 years of service he may be said to have been continuously employed by one company, his first service having been with the Pittsburg, Cincinnati & St. Louis as clerk to the General Passenger and Ticket Agent at Pittsburg. In 1874 he was appointed rate and division clerk at Columbus, Ohio, and later was made cashier as well. In 1878 he became General Passenger and Ticket Agent, at Louisville, Ky., of the Jeffersonville, Madison & Indianapolis, now a part of the (Pennsylvania) system, and in 1883 was made Assistant General Passenger Agent, at Indianapolis, of the Pennsylvania Lines West of Pittsburg. In 1889 he was transferred to Cincinnati in the same capacity, and in 1893 to Chicago. He was a passenger traffic officer of recognized ability, but his friends as well as his associates in the service will best remember him as a man of kindly disposition, considerate and lovable.



ELECTIONS AND APPOINTMENTS.

Baltimore & Ohio.—A. W. Thompson, hitherto Division Engineer of Maintenance of Way, has been appointed Superintendent of the Cumberland Division, with headquarters at Cumberland, Md., succeeding F. A. Husted, resigned. H. H. Temple, Division Engineer of Maintenance of Way at Connellsville, Pa., has been appointed to succeed Mr. Thompson at Pittsburg.

W. T. Lechlider has been appointed Assistant to the General Superintendent of Transportation, with headquarters at Baltimore, Md. There are now two officers holding this title, Mr. Lechlider and Mr. Voorhees.

Boston & Maine.—Charles B. Morrill has been appointed General Western Passenger Agent, with headquarters at Troy, N. Y., succeeding C. A. Nimmo, resigned.

Buffalo, Rochester & Pittsburg.—J. H. Barrett, hitherto General Superintendent of the Chicago & Alton, has been appointed General Superintendent of the B., R. & P., with headquarters at Rochester, N. Y., succeeding George E. Merchant, who has been appointed General Agent.

Canadian Pacific.—R. E. McArthur has been appointed Resident Engineer for the Western Division, with headquarters at Calgary, Alberta.

Central Vermont.—A. Buchanan, Jr., hitherto Master Mechanic of the Delaware & Hudson, has been appointed Superintendent of Motive Power of the C. V., with headquarters at St. Albans, Vt., succeeding T. A. Summerskill, resigned.

Chicago & North Western.—The headquarters of C. C. Hughes, General Superintendent (Nebraska & Wyoming Division), have been removed from Omaha to Norfolk, Neb.

Chicago, Peoria & St. Louis.—H. W. Berger has been appointed Secretary, Treasurer and Auditor, with headquarters at Springfield, Ill., succeeding Ralph Blaisdell, resigned.

Chicago, Rock Island & Pacific.—J. McDonough has been appointed Master Mechanic at Dalhart, Texas, with authority also over the Chicago, Rock Island & El Paso. He succeeds W. W. Leeman, who has been transferred to succeed W. E. Anderson, as Master Mechanic at Goodland, Kan. L. B. Holt, hitherto Division Engineer, has been appointed Assistant Superintendent, with headquarters at Des Moines, Iowa. K. J. C. Zink has been appointed to succeed Mr. Holt at Des Moines. Mr. Holt's position is a newly created one.

Chicago, Rock Island & Texas.—This company has been consolidated with the Chicago, Rock Island & Gulf,

and three divisions have been created. The Southern Division will embrace the lines from Dallas to Terrel, Ind. T., the Amarillo Division from Amarillo to Texela, and the Mexican Division from Bravo to Texokoma. S. B. Hovey continues as Vice-President and General Superintendent and will have the supervision of the Southern Division. H. P. Greenough becomes Superintendent of Amarillo Division, with headquarters at Amarillo; H. P. Conlon is to be Superintendent of Mexican Division, with headquarters at Dalhart, and J. Myers has been appointed Division Freight Agent of the consolidated lines, with headquarters at Dalhart. J. C. McCabe will be General Freight Agent, and W. H. Firth General Passenger Agent of the merged roads.

Delaware & Hudson.—A. J. Stone, heretofore Assistant to the General Manager of the Erie and recently appointed Assistant to the Second Vice-President of the D. & H., has been appointed General Superintendent, with headquarters at Albany, N. Y. C. D. Hammond, hitherto Superintendent at Albany, has been appointed General Agent, transportation department, with headquarters at Albany. H. E. Gilpin, formerly with the Erie, has been appointed Superintendent of the Pennsylvania Division, with headquarters at Carbondale, Pa., succeeding C. R. Manville, resigned. P. H. Connors, hitherto Assistant Superintendent at Albany, has been appointed Superintendent of the Susquehanna Division, with headquarters at Oneonta, N. Y. A. T. Benjamin has been appointed Superintendent of the Saratoga Division, with headquarters at Albany, and D. F. Wait in turn has been appointed Superintendent of the Champlain Division, with headquarters at Plattsburg, N. Y.

J. F. Osborne has been appointed Acting Master Mechanic of the Saratoga and Champlain Divisions, with headquarters at Green Island, N. Y., succeeding A. Buchanan, Jr., resigned. See Central Vermont.

Erie & Central New York (Delaware, Lackawanna & Western).—The officers of this company are: President, W. H. Truesdale; Vice-President, E. E. Loomis; Secretary and Treasurer, F. F. Chambers, and Assistant Treasurer, A. D. Chambers. See R. R. News under D., L. & W.

Houston & Texas Central.—W. Doherty has been appointed Assistant General Passenger Agent, with headquarters at Houston, Texas.

Illinois Central.—F. Ehretsman, hitherto Trainmaster, has been appointed Superintendent, with headquarters at Fulton, Ky.

Mobile, Jackson & Kansas City.—R. A. Christian, Purchasing Agent, with headquarters at Mobile, Ala., has resigned.

New York, Susquehanna & Western.—H. E. Gilpin, General Superintendent, having resigned, that position has been abolished. A. C. Elston, formerly Chief Despatcher, has been appointed Superintendent. See Delaware & Hudson.

Northern Central.—See Pennsylvania.

Pennsylvania.—R. T. Morrow, hitherto Assistant Superintendent at Uniontown, Pa., has been appointed Superintendent of the Western Pennsylvania Division, with headquarters at Allegheny, Pa., succeeding F. F. Robb. W. L. Cooper, hitherto Assistant Engineer of the Northern Central, has been appointed to succeed Mr. Morrow at Uniontown.

St. Louis & San Francisco.—H. M. Fickinger, hitherto Superintendent, has been appointed General Superintendent of the Texas Lines of this company, with headquarters at Fort Worth, Texas. J. A. Quinn, hitherto Superintendent at Neodesha, Kan., has been appointed to succeed Mr. Fickinger at Memphis, Tenn.

Santa Fe Central.—C. W. Fay has been appointed Car Accountant, with headquarters at Santa Fe, N. Mex., succeeding J. H. Kirby.

Seaboard Air Line.—B. S. Guinness, C. Sidney Shepard, Oakleigh Thorne, William A. Marburg and James H. Dooley have retired as voting trustees of the S. A. L., their successors being Thomas F. Ryan, S. Davies Warfield, T. Jefferson Coolidge, Jr., and James A. Blair and John B. Dennis, of Blair & Co. The voting trust has been reorganized and now consists of these five men and John Skelton Williams, B. F. Yoakum and H. Clay Pierce.

Union Pacific.—W. S. Pierce, General Counsel at New York City, has resigned.

LOCOMOTIVE BUILDING.

The Georgia Southern & Florida is having one locomotive built at the Baldwin Works.

The Chicago & Western Indiana is having five locomotives built at the Baldwin Works.

The American Sugar Refining Company is having one locomotive built by the H. K. Porter Co.

The Dominion Atlantic Railway & Steamship Co. is having one locomotive built at the Baldwin Works.

The Pearl & Leaf River is having one locomotive built at the Dunkirk Works of the American Locomotive Company.

The Central Vermont is having three locomotives built at the Schenectady Works of the American Locomotive Company.

The Susquehanna & New York is having one locomotive built at the Dickson Works of the American Locomotive Company.

The Duluth, Missabe & Northern is having six locomotives built at the Pittsburg Works of the American Locomotive Company.

The Tehuantepec National (Mexico) is having four locomotives built at the Pittsburg Works of the American Locomotive Company.

The Michigan Central is having six locomotives built at the Schenectady Works of the American Locomotive Company in addition to the four reported in our issue of Oct. 23.

The United Railroads of Yucatan are having five narrow gage 10-wheel locomotives built at the Baldwin Works. The company has also placed an order for one narrow gage switch engine, and one standard gage Atlantic type (4-4-2) locomotive.

CAR BUILDING.

The Pennsylvania is having 19 coaches built by the Pullman Company.

The American Car & Foundry Company has miscellaneous orders for four cars.

The Southern has ordered six postal cars from the American Car & Foundry Company.

The Vandalia has ordered three cabooses from the American Car & Foundry Company.

The Atchison, Topeka & Santa Fe is having four coaches built by the Pullman Company.

The Minneapolis, St. Paul & Sault Ste. Marie is reported in the market for freight equipment.

The Atlantic & Birmingham has ordered nine coaches from the American Car & Foundry Company.

The Oregon & Eureka is having 50 freights built by the South Baltimore Steel Car & Foundry Co.

The Pittsburg, Cincinnati, Chicago & St. Louis is having 20 coaches built by the Pullman Company.

The Astoria & Columbia River is having 40 freights built by the South Baltimore Steel Car & Foundry Co.

The New York Central & Hudson River is having 150 freights built at the Berwick Works of the American Car & Foundry Company.

The Nelson Morris Packing Company, Chicago, as reported in our issue of Oct. 9, is building 200 refrigerator cars of 60,000 lbs. capacity at its own shops. These cars will be 34 ft. long and 9 ft. 4 in. wide, and will have the following equipment: Diamond trucks, Simplex bolsters and brake-beams, Gould couplers and draft rigging, La Flare door packing, Griffin wheels, Ajax journal bearings and Pittsburg Spring & Steel Company's springs.

BRIDGE BUILDING.

AKRON, OHIO.—The city council is considering the building of a viaduct with a steel span 165 ft. long at Mill street, to cost about $95,000.

ALLIANCE, OHIO.—The County Commissioners may build a bridge 150 ft. long to replace the present bridge over the Mahoning River at Gaskill street.

BELVIDERE, N. J.—The Delaware Bridge Co., local reports state, will try to raise $40,000 by subscription, to build a steel bridge over the Delaware River.

BRIAR BLUFF, ILL.—The Chicago, Burlington & Quincy, it is reported, will build a new bridge over Green River.

CANTON, N. Y.—A bill authorizing the town of Canton to borrow $15,000 has been submitted to the Board of Supervisors. The proceeds are to be used for building a steel arch and concrete bridge over the west channel of Grasse River.

CHICAGO, ILL.—Separate bids are wanted Jan. 27, by the Board of Trustees of the Sanitary District of Chicago, for building the substructure and superstructure of a bridge at Dearborn street over the Chicago River. Thomas A. Smyth is President of the Board.

CORNING, IOWA.—Adams County has voted to issue bonds for $30,000 for bridges.

DAYTON, OHIO.—Bids are wanted Dec. 22, by Wm. F. Miller, Clerk of the Board of Public Service, for the building of a concrete steel bridge 710 ft. long and 42 ft. wide, with 10-ft. sidewalks, over the Miami River at Third street. Plans can be seen at the office of the City Civil Engineer, also at the office of the Concrete Steel Engineering Company, Park Row Building, New York.

DERBY, CONN.—Bids may be asked next month for the building of a bridge 240 ft. long and 55 ft. wide over the Naugatuck River, at a cost of about $100,000. Wm. Meussier, of the Concrete Steel Engineering Company, New York, is the engineer.

HAVRE DE GRACE, MD.—Plans for rebuilding the Philadelphia, Baltimore & Washington Railroad bridge at Havre de Grace have not been developed in detail, and no definite information will be given out for several months.

HUNTINGBURG, IND.—Bids are wanted Dec. 17, by A. H. Koerner, Auditor of DuBois County, for building a steel bridge in Cass Township, also one in Madison Township.

IONIA, MICH.—The Ionia & Grand Rapids Interurban surveyors, it is reported, are at work locating the site for the Ionia bridge.

JERSEY CITY, N. J.—The following are the bids for the new Newark Plank Road Bridge, across the Hackensack River, received Dec. 1: Fagan Iron Works, Hoboken, N. J., $586,477; Sanford & Harris Co., Newark, N. J., $515,000; Joseph H. Cutley, Jersey City, $474,000; F. M. Stillman Co., Jersey City, $524,000; King Bridge Co., $575,000; Berlin Construction Co., for bridge operated by electricity, $539,000, and operated by steam $541,000. The Scherzer Rolling Lift Bridge Co., of Chicago, submitted an informal bid, which was rejected. All bids have been referred to the Bridge Committee.

LAWRENCE, KAN.—The bids received Nov. 14 for building a bridge over the Kansas River at Endora were all rejected and new ones are asked by the County Commissioners. (Nov. 6, p. 803.)

LIVERMORE, COLO.—Bids are wanted by John E. Ramer, Lorimer County Clerk, Fort Collins, Colo., for the building of a steel bridge 64 ft. long over Cache la Poudre.

MILWAUKEE, WIS.—The Common Council has directed the City Engineer to draw plans and estimate the cost of two bascule bridges to replace the present structures at East Water and at Michigan streets.

MINERAL WELLS, TEXAS.—A vote will be taken Dec. 19, by Palo Pinto County, on issuing $40,000 of bonds for building two bridges over the Brazos River.

MINNEAPOLIS, MINN.—Plans have been submitted to the City Engineer for two new viaducts at Western avenue, to replace those recently destroyed by floods.

MONTGOMERY, ALA.—The Board of Revenue of Montgomery County has granted a franchise to Belton Mickle of Selma, to build a steel toll bridge over the Alabama River somewhere between Montgomery and the junction of the Coosa and Talapoosa rivers.

NORTH BAY, ONT.—The Ontario Government will soon ask bids for building the superstructure of a steel bridge 350 ft. long over the Montreal River, about 65 miles from North Bay, on the Temiskaming & Northern Ontario R. R. Several other smaller bridges will also be built along the line of this road. W. B. Russell is Chief Engineer.

PLYMOUTH, PA.—A bridge may be built over the Susquehanna River from Hanover street to Hanover Township.

PORTLAND, ORE.—The contract for building the Morrison street steel bridge may not be awarded until the City Council has time to get prices from eastern bidders. W. C. Elliott is City Engineer.

QUEBEC, QUE.—A contract, it is reported, has been awarded by the Quebec Bridge Company, to M. P. Davis, of Ottawa, to build the south and north approaches to the new bridge over St. Lawrence River. The length of the approaches aggregates about 10 miles. The contract also includes a steel bridge 800 ft. long over the Chaudiere River in the County of Levis.

ST. CATHARINES, ONT.—Bids are wanted Dec. 7, by the City Clerk, for the steel superstructure, concrete piers, abutments and approaches of a steel bridge over the Grand Trunk and the Niagara, Toronto & West Catharines Ry. on Queenstown street. Plans are at the office of R. E. Speakman, City Engineer.

SCRANTON, PA.—The city has been asked to join with the Scranton Railway Co. in building a two-track viaduct 20 ft. wide over Mulberry street and Mifflin avenue.

TOLEDO, OHIO.—The County Commissioners may soon ask bids for a new 80-ft. steel bridge over Ten-Mile Creek in West Toledo.

WILLIAMSPORT, PA.—The National Construction Company of Philadelphia has offered to build a steel toll bridge over the Potomac River at Williamsport.

Other Structures.

BALTIMORE, MD.—Permits have been issued to the Western Maryland by the Building Department for a one-story wooden coal pier, 60 ft. x 1,276 ft., which is to have concrete and wooden piles, to be built by the Degnon Contracting Company. It will cost, with the apparatus for loading coal into vessels, about $141,000; also a one-story steel and wooden freight house 110 ft. x 825 ft., to be built by the Baltimore Bridge Company at a cost of $45,000, and a steel boiler and engine house 52 ft. x 94 ft., to cost $25,000.

CEDARTOWN, GA.—The building of a roundhouse and shops at Cedartown, on the Chattanooga Division of the Central of Georgia, we are told, has been indefinitely postponed.

CHATHAM, ONT.—The Wabash is negotiating for land on which to build repair shops.

CUYAHOGA FALLS, OHIO.—The Falls Hollow Staybolt Co. will double the capacity of its shops by an addition of 50 ft. x 200 ft.

DALLAS, TEXAS.—The Houston & Texas Central, local reports state, has under consideration plans for the building of a new roundhouse, repair shops and offices, and will spend about $100,000 to increase its terminal facilities at East Dallas.

FINDLAY, OHIO.—The Van Buren, Heck & Marvin Co. will build a machine shop 150 ft. x 250 ft. and a foundry 60 ft. 80 ft.

GOMEZ PALACIO, MEX.—It is stated that the Mexican Central has signed a contract with the Government of the State of Durango, Mexico, binding itself to build large shops at the town of Gomez Palacio, at a cost of $100,000, for which the Government donates to the company a large tract of land in the valley of the Nazes River.

GRAND RAPIDS, MICH.—The Perkins Company will build a new foundry 50 ft. x 80 ft., at Grand Rapids. The building will be of concrete construction.

MAHWAH, N. J.—The American Brake-Shoe & Foundry Company, it is reported, will double the size of its shops at this place.

MONTREAL, QUE.—Plans for the projected two-story steel sheds on the Montreal wharves have been prepared and await the approval of the Department of Public Works. J. Kennedy is Chief Engineer for the Montreal Harbor Commissioners.

NEWARK, N. J.—The Newark Malleable Iron Company, which was recently incorporated, will build a new foundry of brick about 100 feet square, and rebuild other buildings at its new plant in Newark, N. J. Jas M. Cory, 305 Roseville avenue, Newark, is Manager.

SAGINAW, MICH.—A. F. Bartlett & Co., of Saginaw, Mich., makers of engines, are replacing their buildings recently damaged by fire. The improvements include the rebuilding of the erecting room, 60 ft. x 100 ft., and a new one-story steel warehouse 108 ft. x 150 ft.

ST. THOMAS, ONT.—The Lake Erie & Detroit River will build shops to cost about $70,000 at St. Thomas.

SAN DIEGO, CAL.—The San Diego Union Railway & Ship Terminal Company has been incorporated in California, and is to build a union station for use of the railroads entering San Diego, and will also build a steamship wharf.

SANTA ROSA, CAL.—Bids for the building of the new California Northwestern station to cost about $30,000 were rejected and new ones will be asked.

SPARTANBURG, S. C.—The Southern, it is reported, will build a new union passenger station of brick, to cost about $20,000.

SPOKANE, WASH.—The Spokane Traction Company, local reports say, will build car barns and make other improvements, at a cost of about $150,000, the work to commence early in the spring. Temporary car barns will be built.

TACOMA, WASH.—The Northern Pacific, local reports say, will build a new hospital either of brick or stone at a cost of $100,000.

TOLEDO, OHIO.—The United States Malleable Iron Co. has purchased nine acres and will build shops consisting of main building 320 ft. x 75 ft., with two "L's" each 50 ft. in length; pattern shop 70 ft. x 40 ft., and storage and office buildings. The company was organized in August with capital of $100,000 under the laws of West Virginia. The officers are: Robert C. Pew, President; P. T. Craig, Vice-President; W. H. Jeffrey, Secretary.

VINCENNES, IND.—A company, of which J. R. Cavanaugh, of the C., C., C. & St. L., and O. W. Winkelhofe, of Indianapolis, and H. E. Trague, of Cincinnati, will be directors, is planning to build a big car factory at this place to employ about 750 men, and have a capacity of 25 finished cars, with repairs to a similar number per day.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

ATCHISON, TOPEKA & SANTA FE.—This company contemplates extending the Cane Belt R. R., which it recently purchased, from its present terminus at Matagorda, Texas, into Mexico. President Ripley is quoted as saying: "We contemplate the building of a line to be called the Eastern Railway of Mexico, which will be about 500 miles long, and will cost between 13 and 14 millions. Work will not be taken up for two or three years, and will be contingent upon the business and financial situation."

ATLANTIC COAST LINE.—An officer writes that grading is practically finished on the extension from Punta Gorda, Fla., southeast to Fort Myers, 28 miles. Track has been laid as far as the Caloosahatchie River. The work is very light, with maximum curvature of 3 deg., and maximum grades of .3 of 1 per cent. There will be one steel drawbridge 135 ft. long over the Caloosahatchie River which is now being built by the American Bridge Company. The road runs southeast from Punta Gorda for a distance of 22 miles, when it crosses the Caloosahatchie River, and runs westerly along the south side of the river to Fort Myers, the present terminus. G. S. Baxter & Co., Jacksonville, Fla., have the contract for building the line. (Nov. 13, p. 822.)

ATLANTIC R. R.—Incorporation has been granted this company in North Carolina. It is stated that the object of the company is to lease the Atlantic & North Carolina and to build an extension of the road from Goldsboro west to Raleigh, 50 miles. J. A. Mills, Raleigh; G. A. Norwood, Jr., Goldsboro, and others are incorporators.

BAKERSFIELD & VENTURA (ELECTRIC).—It is reported that this company has begun work on its proposed line from Los Angeles through Bakersfield to San Francisco. The work is being done by the company's forces. H. H. Russell, Los Angeles, Cal.; J. M. Bursen, Ventura, Cal., and others are interested. (Oct. 2, p. 713.)

BATH TERMINAL.—A charter has been granted to this company to build a railroad two miles long from Jacksonville, Pa., to Bath. It will connect the Central of New Jersey with the Lehigh & New England.

BELINGTON & NORTHERN (WABASH).—A decision has recently been given which grants to this company right of way on the west bank of the Tygarts' Valley River, between the mouth of the Middle Fork and Buckhannon rivers, West Virginia. This decision was the result of a suit brought by the Baltimore & Ohio to prevent the Wabash from passing through a section of Randolph and Barbour Counties, W. Va.

BRUSH VALLEY.—A charter has been granted this company in Pennsylvania to build a railroad five miles long, from Foust's Mills, Indiana County, to the mouth of Brush Creek. J. W. Irish, Norristown, Pa., is interested.

BUFFALO, ROCHESTER & PITTSBURG.—An officer writes that grading is completed on the extension from Indiana Junction, Pa., to Black Lick, 45 miles, and from Elders Ridge to Iselin, 20 miles. Track has been laid on the former extension for a distance of 30 miles, and on the latter for a distance of 10 miles. J. M. Floesch, Rochester, N. Y., is the engineer in charge of the work.

CAROLINA & TENNESSEE NORTHERN.—Work is reported in progress on this line from Bushnell, N. C., to the Tennessee State line, 25 miles. The road will eventually be extended along the Tennessee River to Maryville, Tenn. W. J. Oliver, Knoxville, Tenn., has the contract for grading.

CHESAPEAKE & OHIO.—An officer writes that work is now in progress on the Big Sandy extension from Whitehouse, Ky., to the mouth of Elkhorn River, 77 miles. The maximum grade is .2 of one per cent., and the maximum curvature is 8 deg. There are 11 steel bridges varying in length from 60 ft. to 150 ft. The work includes one tunnel 400 ft. long. Langhorne, Johnson & Co., Richmond, Va., have the contract for the grading and masonry work. Track has been laid to a point 6½ miles southwest from Whitehouse. J. F. Cabell, Richmond, Va., is the engineer in charge of the work. (Nov. 20, p. 838.)

CHICAGO & EASTERN ILLINOIS.—This company is extending its second track south from Danville to Terre Haute. It is expected to complete the work as far as Clinton before the end of the year. W. S. Dawley, Chicago, Ill., is Chief Engineer.

CHICAGO GREAT WESTERN.—Announcement has been made that this company will open its new Chicago-Omaha line for passenger and freight traffic on December 6.

CHICAGO, ROCK ISLAND & PACIFIC.—The newspapers say that location surveys are in progress for an extension from a point opposite Burlington, Iowa, to St. Louis. The proposed line will run from Burlington through Henderson County, and thence southwest through Schuyler, Cass and Morgan Counties, crossing the Illinois River at Beardstown. The remainder of the line has not yet been definitely located.

DENVER & RIO GRANDE.—Press reports state that this company is about to build a branch line from Delta, Colo., to the source of the North Fork of the Gunnison River. It is stated that papers will soon be filed asking for an amendment to the charter to provide for this extension. E. J. Yard, Denver, Colo., is Chief Engineer.

DES MOINES UNION.—This company is making plans for building extensive dikes along its tracks adjacent to the Des Moines and Raccoon Rivers. These are for the purpose of protecting the tracks and the factory district of Des Moines against a recurrence of the floods of last spring. Work will be commenced at once.

EASTERN OREGON.—It is reported that rights of way have been secured and work will shortly be begun on this proposed road from Arlington, Ore., to Condon, 46 miles. W. C. Morris, Arlington, is interested.

EL PASO & SOUTHWESTERN.—An officer writes that work is now in progress on an extension from Forest Junction, Ariz., to Osborn, 10 miles. Orman & Crook, Denver, Colo., are the contractors. The company has completed 10 miles of line between Fairbank and Tombstone, and 30 miles from French to Lewis Springs.

FLINT RIVER & GULF.—This company has graded 13 miles of road between Ashburn, Ga., and Sylvester, and two miles of track have been laid. The proposed route is from Ashburn through Sylvester and Camilla to Bainbridge, 90 miles. Connection will be made with the Georgia Southern & Florida at Ashburn, and with the Atlantic Coast Line at Sylvester. C. A. Alford, Willingham, Ga., is President. (Oct. 23, p. 786.)

GEORGIA ROADS.—Press reports state that a logging road will shortly be built from Box Springs, Ga., to Sulphur Springs, four miles. Connection will be made with the Central of Georgia at the latter point. J. T. Broadnax, Box Springs, is interested.

HAYNEVILLE R. R.—Contract for grading this line from Hayneville, Ala., east to Morgantown, has been let to G. W. Pruett. Work is now in progress and about two miles of the line have been graded. R. A. Chapman, Montgomery, Ala., is Chief Engineer, and Willis Breiner, Hayneville, is President. (Oct. 2, p. 714.)

ILLINOIS, IOWA & MINNESOTA.—An officer writes that work is now in progress on this road between De Kalb, Ill., and Rockford. Ten miles have been graded from Aurora in a northerly direction. Wm. Kenefick, Kansas City, Mo., has the contract for grading. H. W. Seaman is President, and I. W. Troxel, Aurora, is Chief Engineer.

JACKSON & KANSAS CITY.—Articles of incorporation have been filed by this company in Tennessee. The proposed route of the road is from a point near Jackson, Tenn., northwest to Dyersburg, 45 miles. H. W. McCorry, M. B. Gilmore, S. H. Wallace, J. E. Page and others, of Jackson, are incorporators.

KETTLE RIVER VALLEY.—It is reported that work will be begun early in the spring on an extension of this line in a northerly direction from Grand Forks, B. C., for a distance of 50 miles. A subsidy of $3,200 per mile was voted to the company at the recent session of the Dominion Legislature.

LAKE ERIE TERMINAL.—Articles of incorporation have been filed by this company in Ohio. It is proposed to build a railroad from Cleveland, Ohio, south to Massillon, 50 miles. C. H. Taylor, Williamson Building, Columbus, Ohio, is interested.

LOUISVILLE & NASHVILLE.—The newspapers say that this company is making surveys for an extension from Linden, Ala., west to Meridian, Miss., 55 miles. It is also stated that the company will build from Hygeia Springs, Tenn., to Clarksville.

MEXICAN INTERNATIONAL.—Press reports state that location surveys have been practically completed for a branch line from Durango, Mexico, to the port of Mazatlan, and that work will shortly be begun. J. G. Metcalfe, Durango, Mexico, is President. (Oct. 2, p. 714.)

MEXICAN ROADS.—A concession has been granted to Garcia Teruel, of Mexico City, for building a railroad from Oaxaca to Tlacolula, 35 miles. Charles East, of Oazaca, is reported to be in charge of the preliminary surveys.

The Mexican Government has granted a concession to J. M. Cervantes to build and operate a railroad from San Mateo, in the State of San Luis Potosi, south to Jiltla, 60 miles. The proposed road will connect with the Mexican Central at San Mateo. According to the terms of the concession, the road must be completed in five years.

MINNESOTA CENTRAL.—Surveys have been completed for this line from Mankato, Minn., in a northerly direction for a distance of 45 miles. The proposed route is from Mankato northeast through St. Cloud to Duluth, 200 miles. D. H. Beecher, Grand Forks, N. Dak., is President. (Oct. 30, p. 786.)

MISSOURI, KANSAS & TEXAS.—Contracts for grading the extension of this line from Georgetown, Texas, to Austin, 25 miles, are to be let at once. The contract calls for the completion of the road by April 1, 1904.

MOREHOUSE & SOUTHWESTERN.—Incorporation has been granted this company in Missouri to build a railroad from Morehouse southwest to Malden, in Dunklin County, 25 miles. Connection will be made with the St. Louis, Iron Mountain & Southern at Morehouse. Clarence Brown, Toledo, Ohio; Wm. Harrison and John Frank, of Cape Girardeau, Mo., are incorporators.

MORELIA & TACAMBARO.—Grading is reported in progress on this railroad which is to be built from Irapuato, Mexico, in a southerly direction to Morelia, and thence on to Tacambaro, 123 miles. A subsidy of $3,000 per kilometer has been granted the company by the Legislature of the State of Michoacan. Connection will be made with the Mexican Central at Irapuato, and with the National R. R. of Mexico at Morelia. (Aug. 21, p. 610.)

PENSACOLA, ALABAMA & WESTERN.—A charter has been granted this company in Florida to build a railroad from Pensacola north to the Alabama State line, 45 miles. The company proposes to run steamers in connection with the railroad. H. L. Covington, of Pensacola, Fla., is President, and W. J. Forbes is Secretary. (Nov. 6, p. 804.)

QUEBEC & LAKE ST. JOHN.—Surveys are reported in progress for a branch line from a point near Beaudet, Que., north to La Tuque, 35 miles. The Dominion Parliament has voted a subsidy, and grading will be begun early next spring. Other branches for which subsidies have been granted are from Jonquieres, the present terminus of the Chicoutimi branch to La Baie, 20 miles; from Roberval to the government wharf at Lake St. John, one mile; and from La Bouchette to St. Andre, 13 miles. A. E. Doucet, Quebec, is Chief Engineer.

RHODES & TONOPAH.—Surveys have been completed for this railroad from Rhodes, Nev., to Tonopah, 63 miles, and it is stated that grading will be begun at once. A. Tripp, Rhodes, Nev., is General Superintendent, and Paul Eigelhart is the engineer in charge of the work. This is the same company as the one reported in our issue of April 17, page 290, under the heading of Tonopah R. R.

SOUTHERN PACIFIC.—An inspection train was run over the Ogden-Lucin cut-off on Nov. 26, but regular trains will not begin running on the new line for some time. The cut-off is 102 miles long, 72 miles of which is on land and 30 miles on a trestle over a corner of the Great Salt Lake. It will save 45 miles, as the old route from Ogden to Lucin was 147 miles long; and it will avoid the heavy grades of the old line, thereby reducing the running time from Ogden to Lucin by about two hours. Work was begun on the cut-off in March, 1902, and the improvement has cost over $4,000,000. The cut-off runs from Ogden west for a distance of 15 miles over level country, before reaching the shore of the lake. It then crosses the east arm of the lake for a distance of nine miles to Promontory Point; then 18 miles across the west arm of the lake, and thence across the Great Salt Lake desert to Lucin, Nev., 102 miles. The cut-off has involved a large amount of careful work, but, as has already been stated in these columns, the reports about the sinking of certain portions of the trestle and embankment in quicksand were unfounded.

TEXAS, NEW MEXICO & WESTERN.—Articles of incorporation have been filed by this company, with headquarters in Dallas, Texas. The road as projected is to run from Dallas in a westerly direction to Roswell, N. Mex., 300 miles. The authorized capital of the company is $500,000. Names of incorporators are not stated.

WESTMORELAND CENTRAL.—A charter has been granted this company in Pennsylvania, to build a railroad from Bolivar to Ligonier, in Westmoreland County, 15 miles. The new line will pass through valuable timber and coal lands in Westmoreland and Somerset Counties. O. E. Hallam, Pittsburg, Pa., is President.

WYOMING ROADS.—Press reports state that the American Drilling Company has let contracts for building a railroad from Casper, Wyo., the terminus of the Fremont, Elkhorn & Missouri Valley, west to Lander, 130 miles. It is stated that work will be begun after Jan. 1, 1904. J. H. Lobell, Cheyenne, Wyo., is interested.

GENERAL RAILROAD NEWS.

CINCINNATI, NEW ORLEANS & TEXAS PACIFIC (QUEEN & CRESCENT).—This company has declared a dividend of 2 per cent. on the common stock out of earnings which accrued prior to June, 1903. This is the first dividend which the company has declared on the common stock since the preferred was issued.

DELAWARE, LACKAWANNA & WESTERN.—This company has bought the Erie & Central New York, which runs between Cortland and Cincinnatus, 19 miles, and, it is said, will operate it in connection with its Binghamton & Syracuse Division. (Nov. 20, p. 838.)

DETROIT SOUTHERN.—Gross earnings for this company for the fiscal year ending June 30 were $1,444,899, an increase of $204,994. Operating expenses increased $94,824, leaving an increase in net earnings of $110,170. During the year the company acquired by purchase the Iron Railway and extended it from its former terminus at Center, Ohio, to Bloom, 15 miles.

METROPOLITAN DISTRICT RY. (LONDON).—Subscriptions at par are now being received by Glynn, Mills, Currie & Co., London, for £500,000 4 per cent. debenture stock of this company. The *Commercial and Financial Chronicle* says: The work of converting the Metropolitan District Railway from steam to an electric road is steadily progressing, and the engineers anticipate that the lines will be equipped and ready for work by the end of 1904. Provision is being made for a large increase in train service, and it is intended eventually to run 40 trains an hour on the main line, as against 18 trains now running. The company intends to apply to Parliament at the coming session for a revision of its rates, involving material reduction of the existing fares. During the year ending June 30, 1903, the company carried 43,203,584 people. When the system is in full working order, the company expects to carry at least 100,000,000 yearly, and it is providing a car seating capacity for 143,000,000 per annum.

MEXICAN CENTRAL.—The offer of this company, made in August, 1903, through Ladenburg, Thalmann & Co., to holders of the 3 per cent. income and registered bonds, to exchange their holdings for debenture certificates, has been withdrawn, owing to the fact that few of the bondholders have availed themselves of the opportunity. The following statement has been issued by H. Clay Pierce, Chairman of the Board of Directors: "Income bonds to an amount satisfactory to the company not having been deposited in accordance with the terms of its offer of Aug. 10, 1903, the offer is withdrawn. Certain holders of these bonds are now represented by committees acting independently and the withdrawal of the offer of the company will permit each bondholder to act independently in his dealings with such committees." (Sept. 11, p. 660.)

NATIONAL OF MEXICO.—It is stated that this company has concluded an agreement for interchange of traffic with the Gould Lines at Laredo, Mex., and, as the National of Mexico has recently been changed to standard gage a through car line between St. Louis and the City of Mexico is talked of.

NEW YORK & PORT CHESTER.—This company's application to the city of New York to operate an electric railroad across certain streets and highways in the Bronx failed to pass the Board of Aldermen by a vote of 36 to 18. The Court of Appeals has sustained the State Railroad Commission in granting to this company a certificate of public convenience and necessity under section 59 of the railroad law, but the company will be unable to go on with its plans unless its application is passed upon by the Board of Aldermen. (Nov. 13, p. 822.)

PERE MARQUETTE.—At a recent meeting of the directors of the New York Central, Canada Southern, Michigan Central, Lake Shore & Michigan Southern and Pere Marquette, two contracts were agreed to granting joint trackage rights over 218 miles of Vanderbilt roads to the Pere Marquette, for the term of 99 years. By obtaining these trackage rights, the Pere Marquette will be enabled to run trains through to Chicago and to Buffalo. The contract provides for the use of the Lake Shore tracks between Porter and Clark Junction, Ind., 18 miles, and for the use of the Michigan Central tracks between Courtright Junction, Ont., and the west end of the International bridge (Buffalo); and also to Niagara Falls. Both contracts will go into effect Dec. 15. The Canadian part of the contract is subject to the approval of the Governor and Council of Canada. It is stated that property has been bought in Chicago for a freight terminal for the Pere Marquette.

UNION PACIFIC.—The gross earnings of this company for the fiscal year ending June 30, 1903, show an increase of $3,574,000. Operating expenses increased $3,187,990, leaving an increase in net earnings of $386,919. The large increase in operating expenses is attributed by the management to the higher cost of labor and materials, and to the losses resulting from the floods last June. The chief increase in operating expenses was in the item of conducting transportation, which increased $2,140,604, or 18½ per cent. During the year $4,695,000 common stock was issued and exchanged for first lien convertible 4 per cent. bonds. Preferred stock was increased by an issue of $18,000. An equal amount was exchanged for Oregon Short Line income B bonds. The $10,000,000 borrowed in Europe in July, 1903, is represented by 5 per cent. collateral notes, due Feb. 1, 1905. This sum was borrowed in order to advance money to subsidiary companies for improvements, betterments and extensions.